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INCLUDING THE
AMERICAN ENGINEER

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Draft Gear Competition Prize Winner

Sixteen papers were entered in the draft gear competition which closed May 15. The majority of them proved to be exceptionally good and the judges have suggested that at least 12 of them are well worth publishing in the Mechanical Edition. The very remarkable thing about the competition is that there is very little duplication in the expression of ideas in these 12 papers. It was not an easy task to decide upon the prize winner, but the honor was finally conferred upon E. W. Newell, a mechanical engineer of Pittsburgh, and a check for \$100 has been forwarded to him. Other contributions which have been accepted for publication are those presented by C. L. Bundy, general foreman of the Delaware, Lackawanna & Western, Kingsland, N. J.; Millard F. Cox; George L. Harvey, mechanical engineer, Chicago; W. H. Hauser, engineer of tests of the Chicago & Eastern Illinois, Chicago; J. W. Hogsett, chief joint inspector, Fort Worth, Tex.; H. C. May, superintendent of motive power, Chicago, Indianapolis & Louisville, Lafayette, Ind.; E. S. Pearce, Chicago; William Schmalzind, foreman of car department, Texas & Pacific, Fort Worth, Tex.; F. H. Sweringen, master car builder, Streets Western Stable-Car Line, Chicago; George Thomson, master car builder, Lake Shore & Michigan Southern, Englewood, Ill., and Myron E. Wells, Ann Arbor, Mich.

Interchange Inspectors' Convention

Up to the year 1898 there was such a marked variation in the interpretation of the M. C. B. rules of car interchange at the large interchange points throughout the country that it was almost impossible for one large interchange point to pass cars through to another similar point without their being refused. About this time the idea was conceived by H. Boutet, chief interchange inspector at Cincinnati, of getting the different chief interchange inspectors of the country together in an endeavor to come to an understanding on a uniform interpretation of the M. C. B. rules. The matter was taken up with the committee on interchange inspection at Cincinnati and the first meeting was held at Cincinnati in April, 1898. There were ten chief interchange inspectors present. This was the beginning of the Chief Interchange Car Inspectors and Car Foremen's Association of America, which will hold its next annual convention at the Hotel Sinton, Cincinnati, August 25-27. Meetings have been held regularly, ever since the organization was formed, at the large interchange points and it is generally conceded that a great deal of good has been accomplished in supplying correct interpretations for the rules of interchange. This association is deserving of all possible encouragement on the part of the railways, and if the practice were to become general of having car foremen attend the meetings there is no question that a great many of the differences which arise in the interpretation of the M. C. B. rules of interchange could be avoided.

July Mechanical Conventions

Two important mechanical associations will hold their annual conventions during July. The International Railway General Foremen's Association will hold its annual meeting at the Hotel Sherman, Chicago, July 14-17, while the American Railway Tool Foremen's Association will hold its sixth annual convention there, July 20-22. Both of these associations have accomplished a great deal of good work and deserve every encouragement. The officers and committees of both have worked hard to provide good subjects for discussion at the conventions and every one who is interested should be prepared to take part in the discussions. The word prepared is used here advisedly: the discussion at most of our conventions is too wordy and much of it means almost nothing. If the members will take a short time to think over what they desire to say and make it as concise and to the point as possible, the

discussion and the business of the conventions will not only be greatly expedited, but the printed proceedings will prove much more attractive and useful than they do in most cases at present. The steps taken by the General Foremen's Association this year in furnishing well printed advance copies of the papers to be discussed, with the idea of omitting the reading of the papers before the convention, should prove a step in the right direction, provided the members will take the trouble to go over these advance copies before they undertake to discuss the papers. Much time is wasted at conventions in the reading of papers that the members could read and study over beforehand to much better advantage.

Competition on Engine House Work This is a final reminder that the competition on engine house work, which was announced in the May issue, will close on July 15. A prize of \$50 is offered for the best article on this subject received before that date. The judges will base their decision on the practical utility of the suggestions made or the practices which are described, and space rates will be paid for articles which are accepted for publication but do not win the prize. No restriction is placed on the subject chosen except that it must be along the lines of the handling of running repairs to locomotives in roundhouses. A number of articles have already been received and others who contemplate taking part in the contest should not delay in sending in their contributions.

More Information Wanted About Draft Gear Thirteen of the 16 papers presented in the draft gear competition favored the friction draft gear. Two of the papers which presented the best arguments for the spring gear have been accepted for publication, but space limitations would not permit their use this month. The combination of the four papers which appear in this issue forms a fairly complete presentation of the draft gear subject. The other eight papers, however, are almost equally as interesting and will be divided into two sets, one to be used in the August number and the other to be published in the September issue. It is quite probable that as you read the four papers in this issue you may find that you have at hand data, or have had certain experiences which will be helpful to our readers in making a more forceful presentation of certain features of the draft gear problem. If you have such data, or if you believe any of the suggestions which are made are incorrect, please write immediately to the editor, giving him such facts as you may consider will be of value in helping to solve this most important problem. If our readers will do this it will help to clear up many of the misunderstandings which have prevented a more intelligent action on the part of many railroad officers in dealing with the draft gear question. Such communications as are accepted for publication will be paid for at our regular space rates. Please consider this as a personal invitation to participate in the discussion on this subject.

The Draft Gear Problem The 12 papers presented in the draft gear competition, which have been selected for publication, cover the subject very thoroughly, with the one exception that too few examples were given of exact service data showing the comparative value of the different types of gears. On the other hand, most of the men who took part in the competition were well fitted, either from long study of the question or from very extensive experience in the handling of car repairs, to discuss the subject to the very best advantage. The 12 papers have been divided into three sets, to be run in successive issues of the Mechanical Edition, and taken as a complete whole will form one of the most impor-

tant contributions on the draft gear subject, and that of the cost of freight car maintenance, which has ever been placed on record. So important is this subject that this will only form the basis of a campaign which we propose to develop in the attempt to bring out definite facts to demonstrate clearly just what types of draft gear give the best results in service.

The four papers presented in this issue each approach the subject from an entirely different viewpoint, and taken together really form one very complete unit in the draft gear discussion. For instance, the prize winner, W. E. Newell, who is a mechanical engineer in Pittsburgh, has apparently studied the subject almost entirely from the standpoint of a designer and engineer. In a simple but attractive form he has summed up the various tests to which he has had access, placing at the head of these certain convincing data based on service conditions. Mr. Thomson the author of the second paper and the master car builder of a most important division on the Lake Shore, has had 24 years of practical experience in car department work. He has made splendid use of this experience and his observations are worthy of the most careful consideration. The third paper, by Mr. Hauser, is more or less of a side light on the draft gear problem and presents authoritative figures showing the rapid increase in the cost of freight car repairs during recent years, which is out of all proportion to the increased capacity or service of these cars. This cannot continue and something must be done immediately to improve conditions in this respect. There seems to be little question but that a proper selection of draft gear will do much to hold these ever increasing costs down. Mr. Wells' paper takes an almost diametrically opposite position. While he apparently believes in the high capacity modern draft gear, he is very strongly of the opinion that the greater part of the damage is due to a careless handling of the cars in switching. Mr. Wells is a very keen observer and his conclusions are based upon an extensive experience in firing and running locomotives in both yard and road service, and in a very considerable amount of experience in caring for and maintaining locomotives on the Chicago, Burlington and Quincy; the Wabash, and the Wheeling & Lake Erie. His comments cannot be passed over lightly.

Mechanical department officers do not want to evade any responsibility. It is up to them to care for and maintain the equipment in first class condition so that it can properly perform its functions. Nevertheless there is no question but that the equipment is very severely abused by the operating department and that on some roads it will be absolutely necessary to take radical steps to overcome this abuse. In fact, it is really surprising that it has been allowed to continue as long as it has. No one who is familiar with switching yard practice, particularly at night, can forget the sounds which undoubtedly remind veterans of a heavy cannonading on a battlefield. In this connection it is interesting to consider the following quotation, which is taken from the first prize article in the Railway Age Gazette competition on the Operation of Large Classification Yards. A. M. Umsler, general yardmaster of the Illinois Central at Centralia, Ill., in the prize winning article, said: "He [the yardmaster] should impress upon his subordinate employees the necessity of doing their work promptly and properly and should not allow them to lose sight of the absolute necessity of handling all equipment carefully. It is an established fact that considerable damage to equipment occurs in a yard, not always of such consequence that a car must be sent to a repair track before it is in condition to go forward, but the draft gear may be so weakened in handling that it cannot pull its part of the weight and sooner or later the weakened part will give way. This is one of the paramount questions of successful yard operation, as a great deal of delay to cars is

directly due to the manner in which they are handled and as a result considerable time is lost by each car in the course of repairs."

The important arguments against the spring draft gear, as developed in the competition, are its lack of capacity and the damage done by the recoil. The strongest criticism of the friction draft gear is its stiffness, which it is claimed does not allow it to come into action sufficiently under ordinary pulling and buffing shocks. We may theorize on the relative merits of the two gears as much as we please and we may criticize the various laboratory tests which have been made as unfair and too much at variance with service conditions, but after all what really counts, and will really settle this entire question, is the actual service results. It is, therefore, not surprising that several of the contributors insist that money would be well spent in developing certain accurate and complete records to show the cost of maintaining the different types of draft gear; and more than that, that it should go beyond this and take into consideration the damage which is done to other parts of the car and even to the lading in the car.

A general manager paused in passing through a terminal freight yard one day and with a thoughtful expression sized up an exceptionally strong bumping post which had been torn and distorted since his last visit. He said: "If there was only some way of determining the exact damage which was done to the equipment when this post was distorted, and if we could present to the crew which did the damage a statement of this expense, before they went off duty or the next day, it might cause them to use more horse sense in handling the cars in the yard." Damaged cars are probably as much an indication of man failure as they are of draft gear failure, and at the same time that the mechanical department officers are analyzing the costs to determine which is the most satisfactory gear, the operating department ought to do its part by seeing that its employees are educated and trained to be more thoughtful in the handling of the cars. It would prove a paying proposition.

Much time and thought and a great deal of expense have been expended by the coupler committee of the Master Car Builders' Association in developing a stronger and standard coupler. The committee which has this work in charge is to be congratulated on the splendid work which it has done. It is not in any spirit of criticism, therefore, that the suggestion is made that a more efficient cushion behind the coupler may do much to finally influence the association to adopt a lighter coupler as standard than many people at this time believe to be necessary under present conditions. Meanwhile every road should do its part in testing the couplers which have been recommended and in collecting and compiling data to show the effect of the different draft gears, or cushions, used behind the various types of couplers either now in use or about to be experimented with.

Last month we suggested in an editorial note that more attention should be given to the maintenance of the draft gear. Surely it is not the least important part of the car, and yet its inspection and its maintenance is very largely overlooked as compared with such parts as wheels, axles, couplers, air brakes, etc. If good performance is to be expected of a draft gear it must be inspected and thoroughly overhauled at regular intervals. One car builder has suggested that this overhauling should be done every four or five years and that the car should be stenciled with the date on which this took place. The proposed interval would probably vary more or less, depending on the make of draft gear used. Gears with several parts subject to more or less wear would have to be looked after more frequently than those with fewer parts and with larger wearing surfaces. So far as we know no practice of this sort now exists on any road. If it does we should like very much to have definite information of it in order

that our many friends who are interested in the draft gear question may have the advantage of the methods which have been followed and the experience which has thus far been gained.

NEW BOOKS

Business Administration. By Edward D. Jones. Bound in cloth. 275 pages. 5 in. by 7½ in. Published by the Engineering Magazine Company, New York.

Believing that the administration of manufacturing and operating companies under modern conditions is developing into a new profession, the author of this book has sought its scientific principles by a study of the older professions with which it is closely allied. His argument is, briefly: that success in dealing with men and affairs depends upon certain basic propositions and laws which can be discovered by studying the work of successful administrators; that the rules and methods followed by masters of business and finance are usually deliberately hidden and there are no records throwing clear full light on their lives and acts; that leaders in statecraft, war and science, on the contrary, are figures of world interest whose careers and practice are illuminated fully and searchingly by public and private records, correspondence, personal reminiscences and even petty gossip. From such data the author has analyzed definite primary principles of administration. In history and the biography of military conquerors, diplomats and scientists, he finds the elementary rules of success.

Tests of Bond Between Concrete and Steel. By Duff A. Abrams. 238 pages, 6 in. by 9 in.; illustrated; bound in paper. Published by the University of Illinois. Copies free on application to C. R. Richards, acting director of the engineering experiment station, Urbana, Ill.

In designing structures of reinforced concrete it is important to know the amount of stress which may be developed between the surface of the reinforcing bars and the surrounding concrete before failure is produced by the slipping of the bars. This stress is what is commonly termed "bond." The above-mentioned bulletin gives the results obtained by pulling out bars embedded in blocks of concrete and also the results of tests made to study the bond stresses developed in large reinforced concrete beams. Nearly 2,000 tests are reported and a wide range of conditions is represented. This is one of the most exhaustive studies of the amount and distribution of the bond stress between concrete and steel which have appeared.

The Tractive Resistance of a 28 Ton Car. By Harold H. Dunn, assistant in railway engineering, University of Illinois experiment station. 53 pages, 6 in. x 9 in.; illustrated; bound in paper. Published by the University of Illinois. Copies free on application to C. R. Richards, acting director of the engineering experiment station, University of Illinois, Urbana, Ill.

This is Bulletin No. 74 and records the results of tests made with a 28-ton electric car of the double end type for the purpose of determining the resistance offered to its motion when running on straight level track in still air at uniform speed, and to ascertain the relation existing between that resistance and the speed of the car. The tests were made on sections of straight track representative of good electric railway construction during generally fair weather when the average temperature was not below 25 deg. F., and when the wind velocity did not exceed 26 miles per hour. The plan of the tests, which involved running the car backward and forward over a selected section of track, made it possible to eliminate wind resistance. The results are finally expressed in the form of a curve whose co-ordinates are car resistance and speed. This curve shows that at 5 miles per hour the car resistance was 5.25 lb. per ton, that at 25 miles per hour it was 13.03 lb. per ton, and that at 45 miles per hour it was 26.12 lb. per ton. The average results from the individual tests did not vary more than 9 per cent from this final curve.

COMMUNICATIONS

ENCOURAGE EMPLOYEES TO STUDY

LOS ANGELES, Cal., February 21, 1914.

TO THE EDITOR:

Referring to the article in the February number of your magazine on the "Development of Young Men in Railroad Work," I suggest that the railroads establish libraries at their general shops and large terminals, these to be in charge of a librarian. All the engineering magazines, as well as other magazines pertaining to the different phases of railroad work should be placed in them. At the end of the year the principal ones should be bound and indexed, the same as in any other library. Important books on railroad work should be included in the list.

Then all employees should be given free access to the library; and all from the sweeper up should be urged to make use of this literature. All apprentices should be required to read a certain amount weekly along the line of their work. This would help develop the young men, make better men out of the older ones, and in general would raise the standard of all connected with the railroads.

EDWARD L. DUDLEY.

BORING ECCENTRIC STRAPS

RICHMOND, Va., May 25, 1914.

TO THE EDITOR:

We recently made a good record boring eight $1\frac{1}{2}$ in. bronze eccentric straps on a New Era type, 42 in. Bullard maximill, at our Seventeenth street shops, Richmond, Va. The actual time consumed in each operation was as follows:

	Chuck time, minutes	Roughing time, minutes	Finish time, minutes	Taking out of chuck, minutes	Time, floor to floor, minutes
1.....	1 $\frac{1}{2}$	3 $\frac{1}{2}$	2	1	8
2.....	1	4	1 $\frac{1}{2}$	1	7 $\frac{1}{2}$
3.....	1 $\frac{1}{2}$	3	2	1	7 $\frac{1}{2}$
4.....	1	3	1	1	6
5.....	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	8
6.....	.1	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1	7
7.....	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	8
8.....	1	4	1	1	7
Total time					59 minutes
Average time per strap, 7 minutes, 22 $\frac{1}{2}$ seconds.					

The straps, when placed at the machine for boring, were otherwise complete, including facing and drilling the T foot to standard.

The method of doing this work is as follows: The chucking is done by first fastening the T foot of the strap with turned bolts to the fixed lug. This lug is securely bolted to the table

of the machine, as shown in Fig. 1. The other jaws are then tightened. No time is lost in setting, as the special lug brings the strap to the proper position when the bolts are tightened. The side is then faced (one cut), as shown in Fig. 2; the rough boring is next done, as shown in Fig. 3, and the finish boring

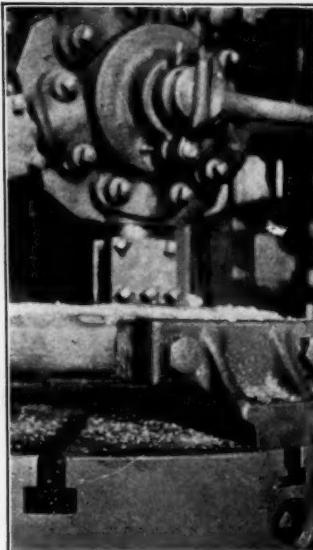


Fig. 1

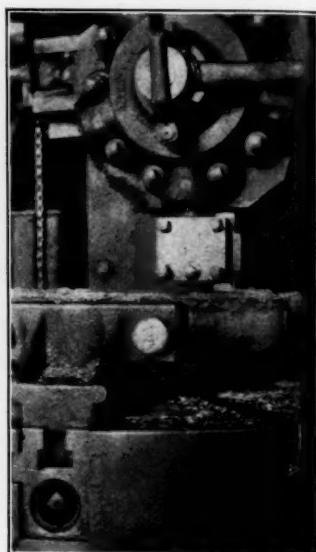


Fig. 4

is then done with a master tool of exact contour, as shown in Fig. 4, making a perfectly smooth finish.

By doing the work in this manner, we have been able to effect a saving in time of 75 per cent over the old methods.

M. FLANAGAN,
Master Mechanic, Chesapeake & Ohio.

USE OF WOOD IN NEW YORK STATE.—According to a statement from the New York State College of Forestry at Syracuse University, New York is the greatest wood consuming state in the Union. It uses over 2,000,000,000 board feet every year in its wood-using industries and for general construction purposes. New York uses about 150 different kinds of foreign and domestic woods in the varied industries.

HOURS OF SERVICE ACT.—During the fiscal year ending June 30, 1913, 306 cases, involving an aggregate of 3,499 violations of the hours of service act, were transmitted to the several United States attorneys for prosecution. During the same period the carriers confessed judgment as to 1,750 counts. Of the 455 counts which went to trial, 186 resulted in favor of and 269 adversely to the Government. Of the latter, 214 counts have been appealed by the Government, and 63 of the 186 counts originally decided in favor of the Government have been appealed by defendants. Penalties aggregating \$100,861.14 were collected, and additional penalties to the amount of \$32,350, in addition to costs previously assessed by the courts, were on July 1, 1913, pending payment by the carriers.

RAILROAD BETWEEN PORTLAND AND QUEBEC.—A public meeting was held in Quebec on Monday, 20th inst., to consider the proper preliminary steps to be taken in favor of this enterprise. J. W. Woolsey was in the chair, K. Fisher, secretary. Mr. A. Smith, one of the commissioners appointed by the state of Maine, was introduced to the meeting and explained the views and wishes of Maine on the subject, all of which tended to increase the facilities of intercourse between the United States and Canada. He was received with cheering, and resolutions were subsequently passed, asking the concurrence of the Governor of Canada in the efforts making by Maine, and in those which the citizens of Quebec stand ready to make.—*From American Railroad Journal, August 1, 1835.*

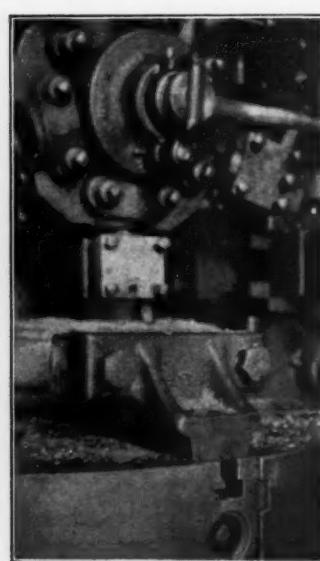


Fig. 1

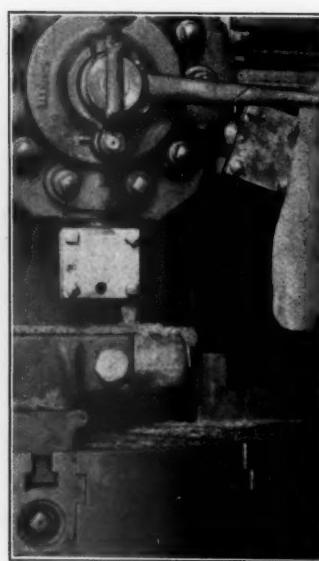


Fig. 2

PENNSYLVANIA MIKADO TYPE LOCOMOTIVE

**Advanced Design with Many Parts Interchangeable
with the Latest Development of the Pacific Type**

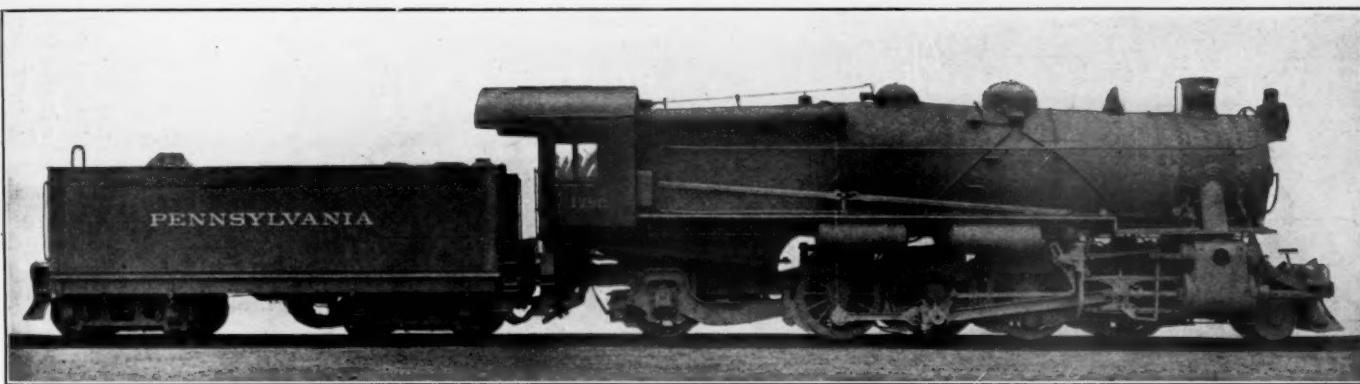
[Editor's Note.—A brief description of the Pennsylvania Mikado and Pacific type locomotives, classes L1s and K4s, was published in the Daily Railway Age Gazette for June 15, 1914, page 1411. Some of the data given in this article were approximations which were all that could be obtained at that time, and will be found to differ slightly from the present figures, which are correct.]

During the past few years there has arisen a need for a larger freight locomotive for use on the main line of the Pennsylvania Railroad between Altoona and Pittsburgh. The employment of

motives has been carried out as far as possible, as well as the use of many of the parts which are embodied in the class E6s Atlantic type locomotive.*

BOILER

The boilers of the Pacific and Mikado locomotives are interchangeable, and an interesting feature is the flanging of the throat sheet in an integral piece with the lower half of the rear barrel sheet. This has permitted of lowering the boiler $1\frac{1}{8}$ in., and at the same time allows sufficient clearance for the

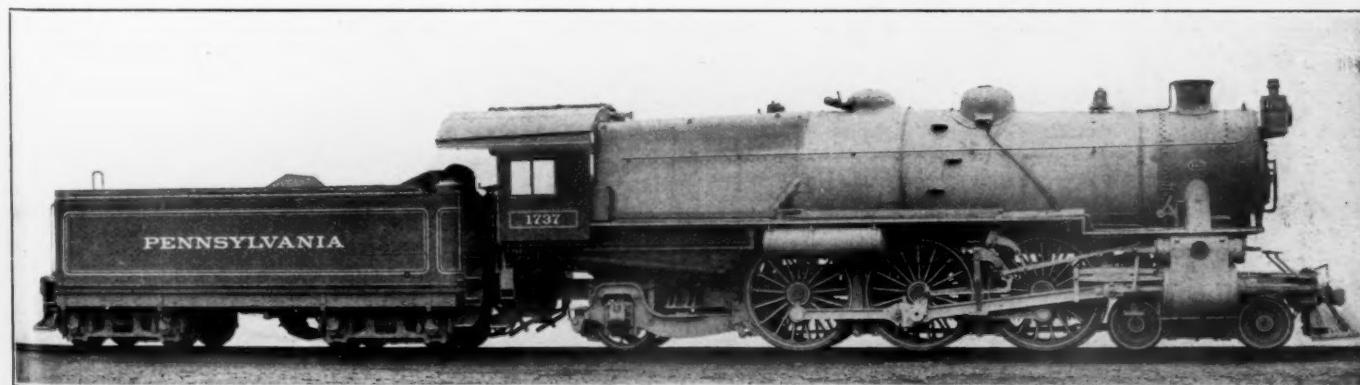


Pennsylvania Mikado Type Locomotive

such an engine is desirable in order to reduce double heading to a minimum, and to avoid the necessity of breaking up trains which arrive at Altoona and Pittsburgh, and sending them forward over the Pittsburgh division in sections. At the same time it was thought desirable to experiment with a heavy Pacific type locomotive for passenger service on this division. There has accordingly been designed and built a Mikado type locomotive which bears the railway company's classification L1s and a Pacific type designated as class K4s.

It was necessary to keep the locomotives within certain limits,

rear driving wheels. The boiler is of the Belpaire type, and has $237\frac{3}{4}$ in. tubes, and $40\frac{5}{8}$ in. superheater flues, all of which are 19 ft. long. The firebox is 126 in. long by 80 in. wide, and is fitted with a combustion chamber; the grate area is 70 sq. ft. The inside diameter of the boiler at the forward end is $78\frac{1}{2}$ in., with an inside diameter of 87 in. at the dome course. The dome is flanged in one piece. The design of smoke stack employed is the result of much study, and an inside extension is used extending below the center line of the smoke box, as will be seen from the engraving.



Latest Development of Pacific Type Locomotive on the Pennsylvania

because of restrictions in road clearance, and make the revolving and reciprocating parts as light as possible consistent with the necessary strength; the weight per pair of driving wheels is limited to 65,000 lb., with a 5 per cent margin for scale variations, and there is also a limitation for dynamic augment due to counterbalance for reciprocating weights, of 30 per cent of the weight on drivers at 70 miles an hour for passenger locomotives and at 294 revolutions per minute for freight locomotives. Interchangeability of parts between the two loco-

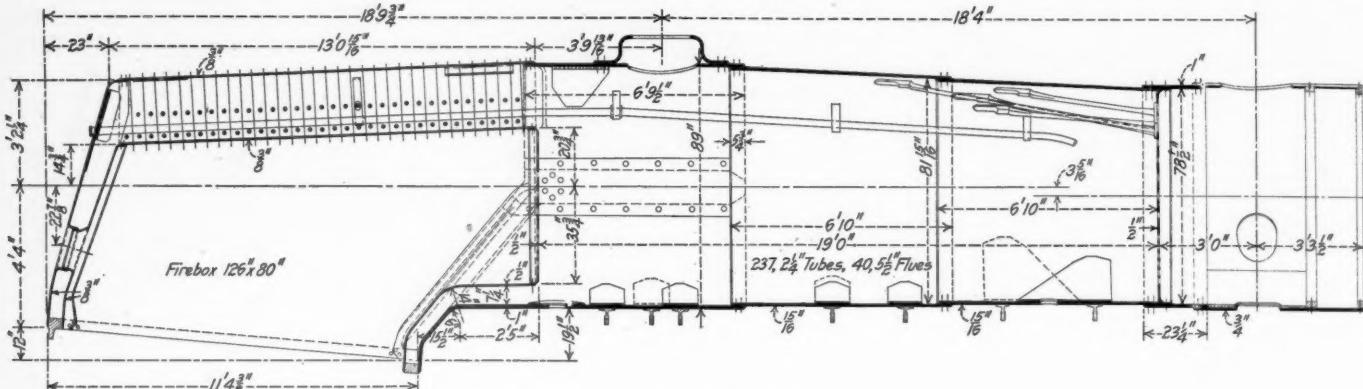
FRAMES AND RUNNING GEAR

The frames are of cast steel, 6 in. wide and reinforced to 8 in. over the driving boxes. Heat-treated steel has been used wherever possible following the same lines in this respect as in the E6s Atlantic type locomotive previously referred to, among the parts in which this material has been employed being the driving axles, crank pins and piston rods, as well as the main

*For description of the Pennsylvania class E6s Atlantic type locomotive see Railway Age Gazette, Mechanical Edition, February, 1914, page 63.

and side rods.[†] In order to reduce the weight as much as possible, and at the same time facilitate the heat treatment, the

The depth of $5\frac{1}{2}$ in. for the milled section of the rod is maintained throughout, and the flanges are $3\frac{5}{8}$ in. wide, while the



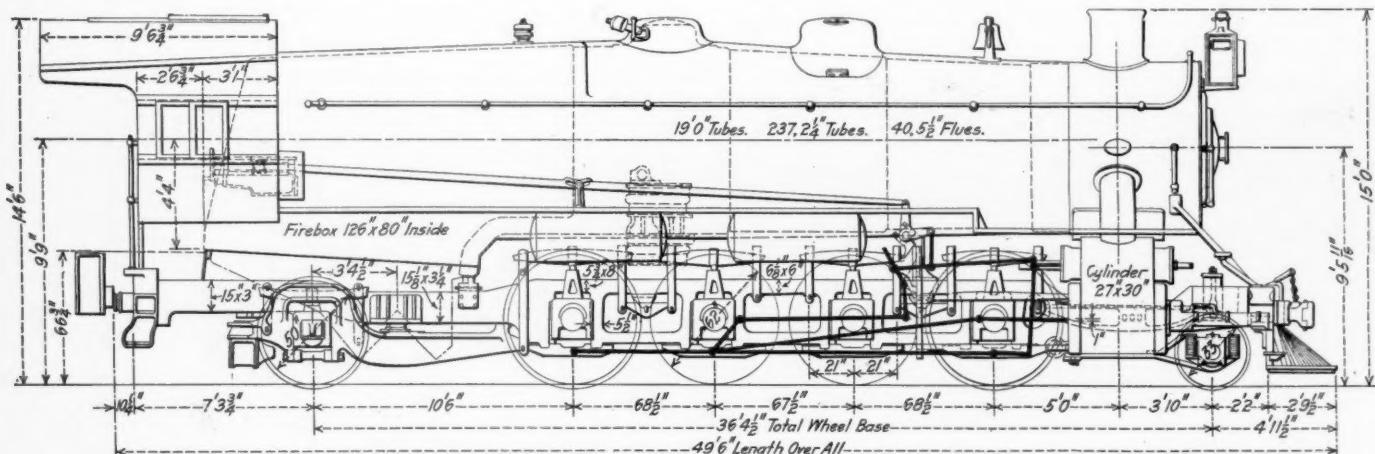
The Bollers of the Pacific and Mikado are Interchangeable

axles, crank pins, wrist pins and piston rods are bored through at the center.

The piston rods are of the extended type, and are $4\frac{1}{2}$ in. in diameter, with a $2\frac{1}{2}$ in. hole through the center except at the

web is $\frac{7}{16}$ in. thick. The side rods of the Mikado are of I-section 5 in. deep, with a $2\frac{1}{2}$ in. by $5\frac{1}{8}$ in. flange and a $3\frac{1}{8}$ in. web.

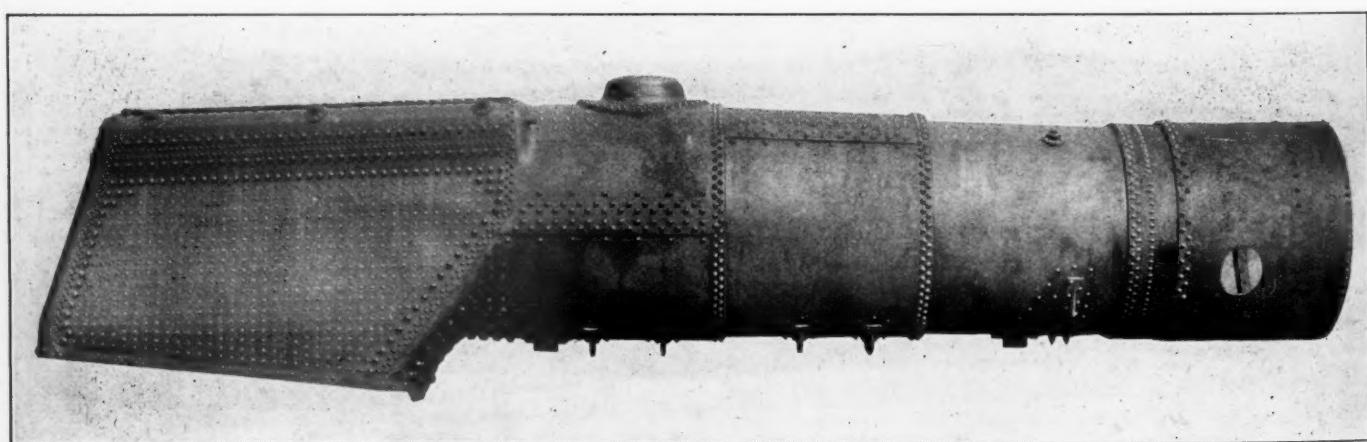
The arrangement of the valve gear is similar to that employed on the Atlantic type locomotive, and the crosshead of



Side Elevation of the Pennsylvania Mikado Type Locomotive

points where the rods are reinforced for the piston and cross-head fits. The driving axles have a 3 in. hole through the center, and the journals are 11 in. by 15 in. The main rods

the Pacific type is also very similar, but a two bar arrangement of guides with an alligator crosshead is employed on the Mikado. The same design of trailer truck is employed on all three



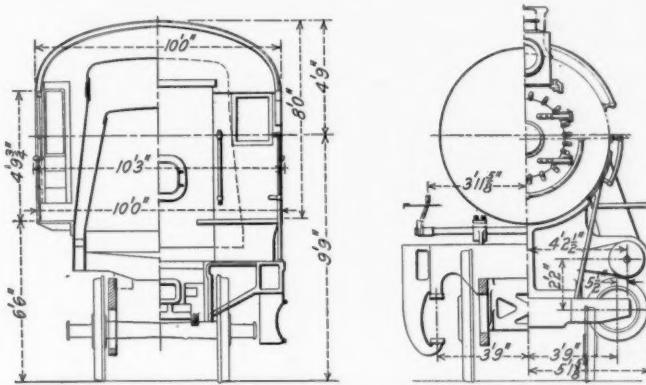
Boller of the Pennsylvania Pacific and Mikado Type Locomotives

are of I section, $8\frac{1}{4}$ in. deep at the rear end, and $7\frac{3}{4}$ in. at the forward end, the flanges tapering from $1\frac{3}{8}$ in. to $1\frac{1}{8}$ in.

[†]The methods employed in connection with the crank pins and piston rods were described in the article on the Pennsylvania Atlantic type locomotive in the February, 1914, issue, page 63.

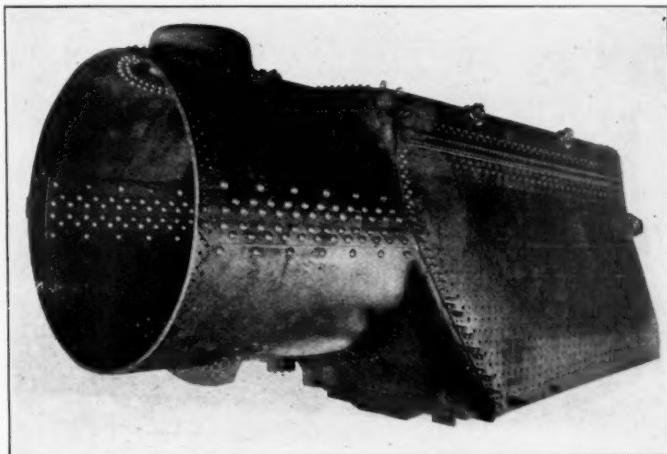
locomotives, the trailing spring gear being equalized with that of the two rear pairs of drivers on the Mikado and Pacific types. The trailing truck frame is a substantial steel casting all in one piece, and constitutes the trailing equalizer as well.

One of the illustrations shows the arrangement of the driver brake cylinders. It was found necessary to use two 16 in. cyl-



End Elevations and Cross Sections of the Mikado Type

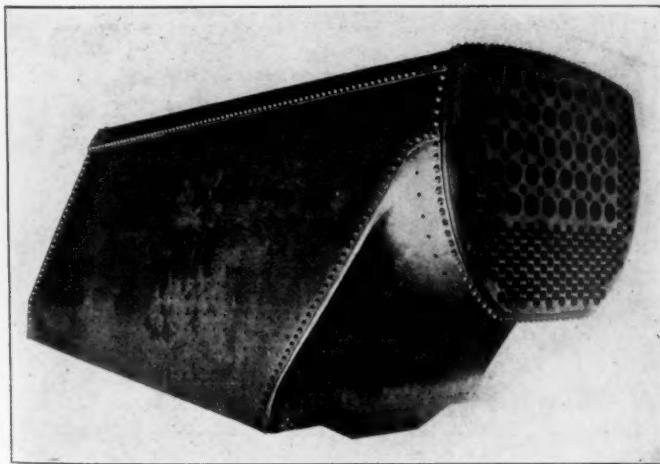
inders, and because of space limitations the arrangement shown was employed.



Outer Shell of the Firebox and Dome Course of the Boiler

OTHER DETAILS

The locomotives are equipped with Schmidt superheaters and Security brick arches. Screw reverse gear is used, and because of its not being necessary to provide space to move the reverse

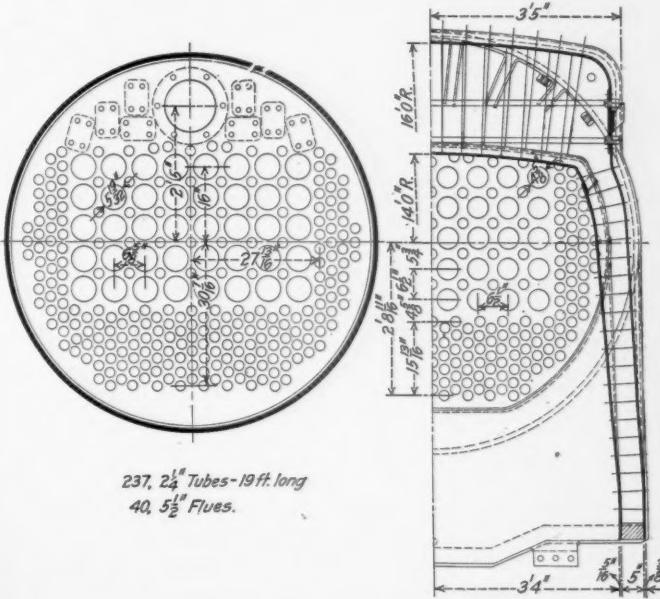


The Assembled Firebox for the Pennsylvania Locomotives

lever the cab has been considerably shortened. It is also believed that the shorter cab will give the engine crews a better opportunity to observe signals. The tender truck is of the same design as that used on the E6s Atlantic type locomotive. The

tank is of the water bottom type with 36 in. wheels and 5 1/2 in. by 10 in. journals. The water capacity is 7,000 gal., and the coal capacity 12 1/2 tons.

These locomotives, as well as the latest design of Atlantic type, were designed in the office of the mechanical engineer of the Pennsylvania Railroad at Altoona, and built in the Juniata shops. The E6s class Atlantic type locomotives are now haul-



Cross Sections Through the Boiler

ing very heavy trains on most exacting schedules, and the service results are amply justifying the design. It is expected that equally satisfactory results will be obtained from the new Mikado and Pacific types.

Tabular comparisons are given below between the Mikado type and the Pennsylvania Consolidation type of the H9s class,



The Lower Half of the Dome Course Is Flanged In One Piece with the Throat Sheet

as well as between the new Pacific type and the E6s Atlantic type:

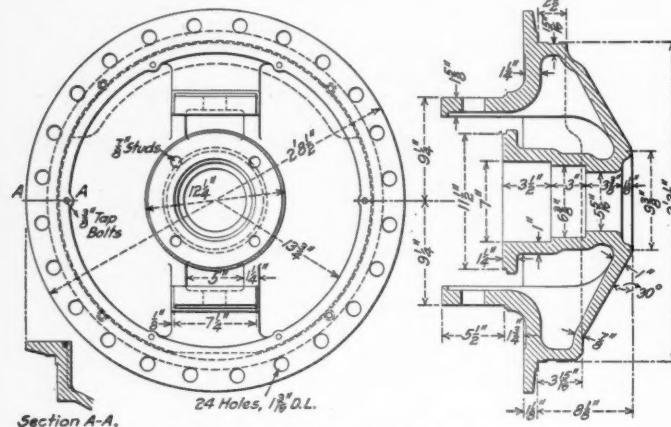
CONSOLIDATION AND MIKADO TYPES

General Data

Railroad classification	H9s	L1s
Type	Consolidation	Mikado
Gage	4 ft. 9 in.	4 ft. 9 in.
Service	Freight	Freight
Fuel	Bit. coal	Bit. coal
Traction effort	46,290 lb.	57,850 lb.
Weight in working order	250,000 lb.	315,000 lb.
Weight on drivers	220,000 lb.	238,000 lb.

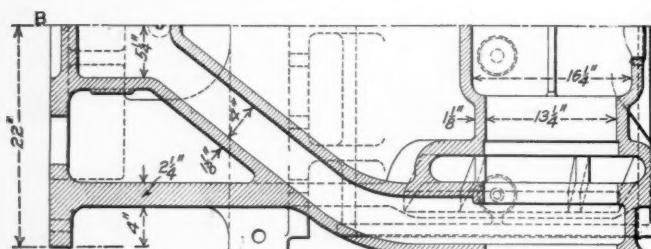
General Data (Continued)

General Data (Continued)			
Weight of engine and tender in working order	408,000 lb.	473,000 lb.	473,000 lb.
Wheel base, driving	17 ft. 0½ in.	17 ft. 0½ in.	17 ft. 0½ in.
Wheel base, total	25 ft. 9½ in.	36 ft. 4½ in.	36 ft. 4½ in.
Wheel base, engine and tender	62 ft. 5¾ in.	72 ft. 3 in.	72 ft. 3 in.
Ratios			
Weight on drivers ÷ tractive effort...	4.75	4.12	4.12
Total weight ÷ tractive effort.....	5.40	5.44	5.44

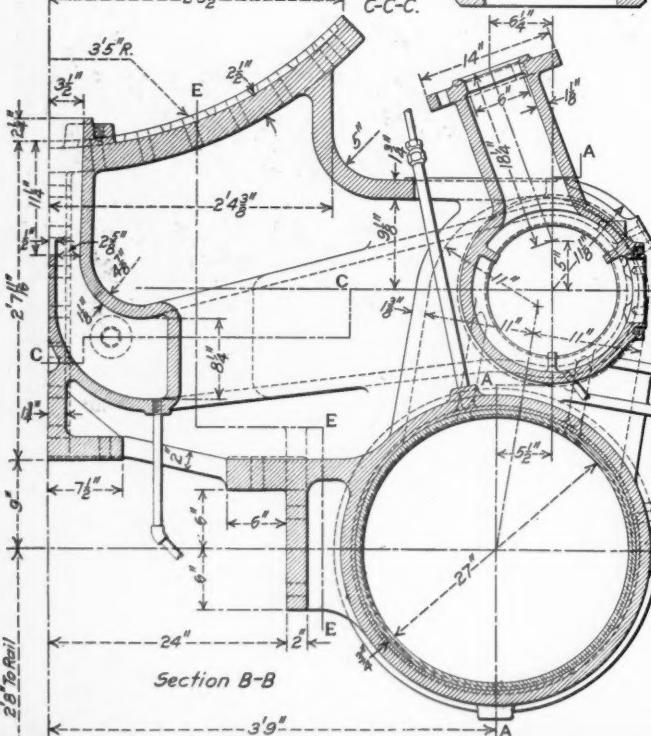


Arrangement of the Back Cylinder Head

Tractive effort \times diam. drivers \div total equivalent* heating surface.....	683	622
Total equivalent* heating surface \div grate area	76.21	82.38
Firebox heating surface \div total equivalent* heating surface, per cent.....	4.45	5.05
Weight on drivers \div total equivalent* heating surface	52.3	41.27



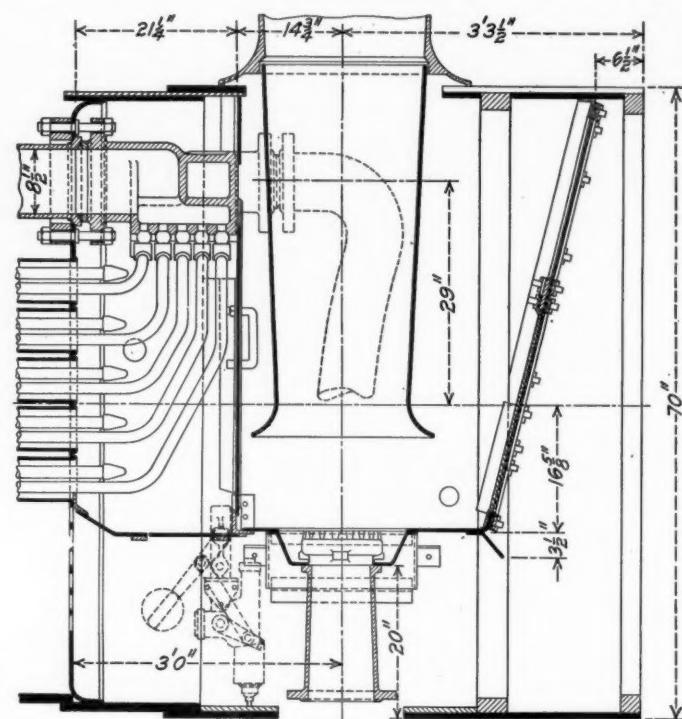
Section



Arrangement of the Cylinders for the Mikado.

Total weight \div total equivalent* heating surface	59.4	54.63
Volume both cylinders, cubic feet	15.91	19.88
Total equivalent* heating surface \div vol. both cylinders	264.1	290.0
Grate area \div vol. both cylinders	3.46	3.52

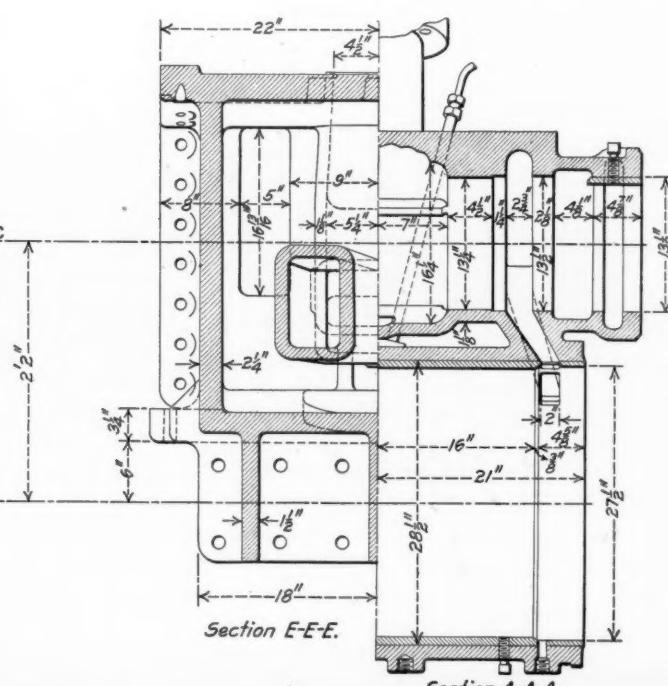
Cylinders Simple Simple
 Kind Simple Simple
 Diameter and stroke. 25 in. x 28 in. 27 in. x 30 in.



Front End Arrangement

<i>Valves</i>	<i>Piston</i>	<i>Piston</i>
Diameter	12 in.	12 in.
Greatest travel	6 in.	6 in.
Outside dia	7/8 in.	7/8 in.

<i>Wheels</i>	62 in.	62 in.
Driving, diameter over tires.....	62 in.	62 in.
Driving, thickness of tires.....	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.



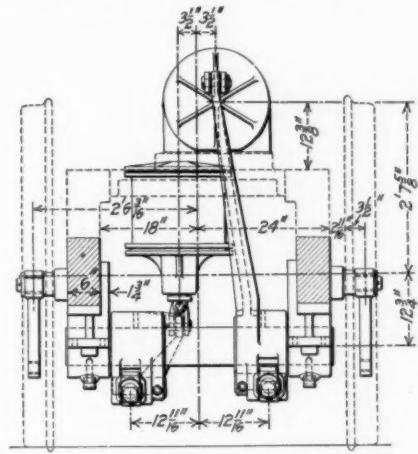
Section E-E

Wheels (Continued)

Driving journals, main, diameter and length	10½ in. x 13 in.	11 in. x 15 in.
Engine truck wheels, diameter	33 in.	33 in.
Engine truck, journals	5½ in. x 10 in.	6½ in. x 12 in.
Trailing truck wheels, diameter	.....	50 in.

Boiler

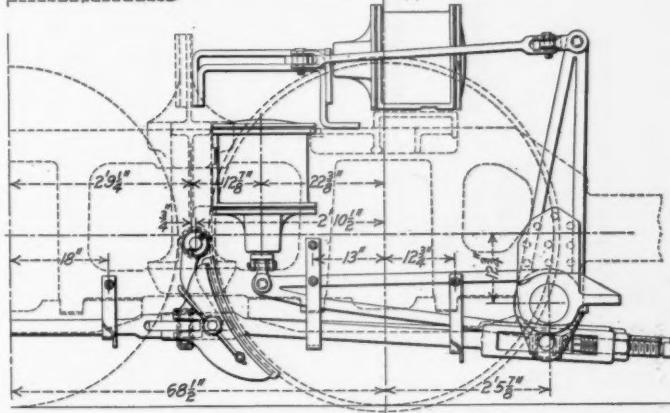
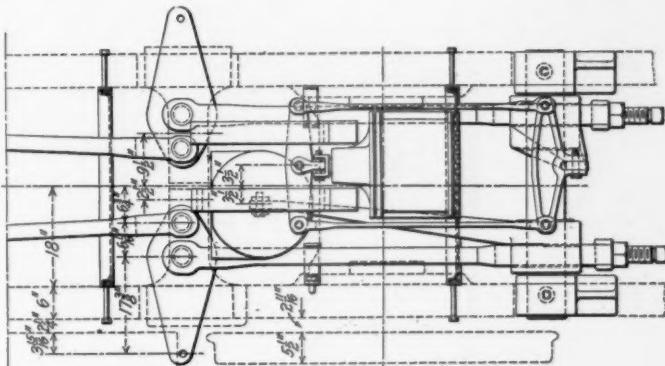
Style	Belpaire	Belpaire
Working pressure	205 lb.	205 lb.
Firebox, width and length	72 in. 110½ in.	80 in. x 126 in.
Firebox plates, thickness	¾ in. & 5/16 in.	¾ in. & 5/16 in.
Tubes, number and outside diameter	265—2 in.	237—2½ in.
Flues, number and outside diameter	36—5½ in.	40—5½ in.
Tubes, length	15 ft.	19 ft.
Flues, thickness	.125 in.	.125 in.
Heating surface, tubes	2,841.2 sq. ft.	3,746.8 sq. ft.
Heating surface, firebox	187 sq. ft.	288.6 sq. ft.
Heating surface, total	3,028.2 sq. ft.	4,035.4 sq. ft.
Superheater heating surface	782.2 sq. ft.	1,153.9 sq. ft.
Total equivalent* heating surface	4,201.5 sq. ft.	5,766.3 sq. ft.



Arrangement of the Driver Brake Cylinders on the Mikado

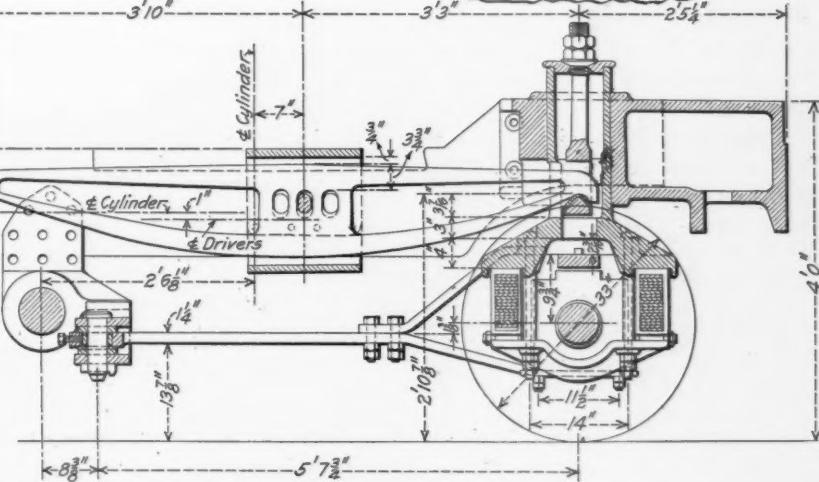
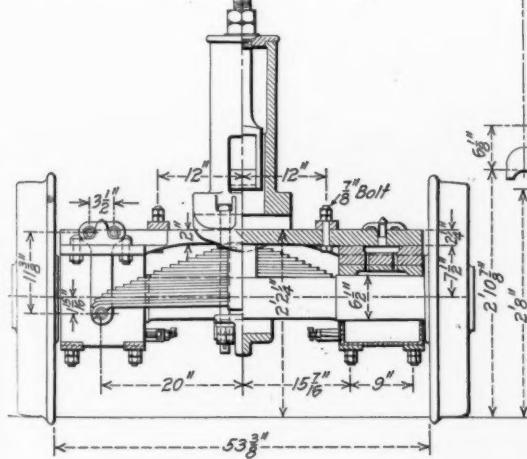
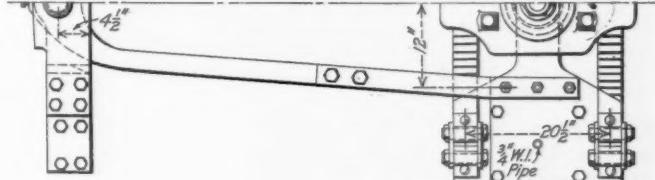
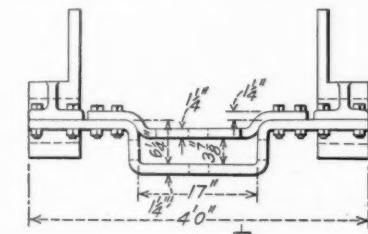
Grate area	55.13 sq. ft.	70.0 sq. ft.
Center of boiler above rail	9 ft. 9 in.	9 ft. 9 in.
Tender		
Tank	Water bottom	Water bottom
Wheels, diameter	36 in.	36 in.

Gage	4 ft. 9 in.
Service	Passenger
Fuel	Bit. coal



Arrangement of the Driver Brake Cylinders on the Mikado

Traction effort	29,427 lb.	41,845 lb.
Weight in working order	240,000 lb.	305,000 lb.
Weight on drivers	133,100 lb.	200,000 lb.
Weight of engine and tender in working order	398,000 lb.	463,000 lb.
Wheel base, driving	7 ft. 5 in.	13 ft. 10 in.



Leading Truck of the Pennsylvania Mikado

Journals, diameter and length	5½ in. x 10 in.	5½ in. x 10 in.
Water capacity	7,000 gal.	7,000 gal.
Coal capacity	12½ tons	12½ tons

Wheel base, total	29 ft. 7½ in.	36 ft. 2 in.
Wheel base, engine and tender	63 ft. 10½ in.	71 ft. 10 in.

Ratios

Weight on drivers ÷ tractive effort	4.52	4.78
Total weight ÷ tractive effort	8.15	7.28
Tractive effort X diam. drivers ÷ total equivalent* heating surface	599.00	580.50

ATLANTIC AND PACIFIC TYPES
General Data

Railroad classification	E6s
Type	Atlantic

K4s
Pacific

Ratios (Continued)			
Total equivalent* heating surface \div grate area	71.30	82.38	
Firebox heating surface \div total equivalent* heating surface, per cent.	4.93	5.05	
Weight on drivers \div total equivalent* heating surface	33.80	34.68	
Total weight \div total equivalent* heating surface	61.00	52.9	
Volume both cylinders, cubic feet	13.10	18.55	
Total equivalent* heating surface \div vol. both cylinders	300	310.80	
Grate area \div vol. both cylinders	4.21	3.77	
<i>Cylinders</i>			
Kind	Simple	Simple	
Diameter and stroke	23½ in. \times 26 in.	27 in. \times 28 in.	
<i>Valves</i>			
Kind	Piston	Piston	
Diameter	12 in.	12 in.	
Greatest travel	7 in.	7 in.	
Outside lap	1 5/16 in.	1 5/16 in.	
<i>Wheels</i>			
Driving, diameter over tires	80 in.	80 in.	
Driving, thickness of tires	4 in.	4 in.	
Driving journals, main, diameter and length	9 1/2 in. \times 13 in.	11 in. \times 15 in.	
Engine truck wheels, diameter	36 in.	36 in.	
Engine truck, journals	6 1/2 in. \times 12 in.	6 1/2 in. \times 12 in.	
Trailing truck wheels, diameter	50 in.	50 in.	
<i>Boiler</i>			
Style	Belpaire	Belpaire	
Working pressure	205 lb.	205 lb.	
Firebox, width and length	72 in. \times 110 1/4 in.	80 in. \times 126 in.	
Firebox plates, thickness	3/8 in. & 5/16 in.	3/8 in. & 5/16 in.	
Firebox, water space	5 in.	5 in.	
Tubes, number and outside diameter	242-2 in.	237-2 1/4 in.	
Flues, number and outside diameter	36-5 3/8 in.	40-5 1/2 in.	
Tubes, length	15 ft.	19 ft.	
Heating surface, tubes	2,660.5 sq. ft.	3,746.8 sq. ft.	
Heating surface, firebox	195.7 sq. ft.	288.6 sq. ft.	
Heating surface, total	2,856.2 sq. ft.	4,035.4 sq. ft.	
Superheater heating surface	721 sq. ft.	1,153.9 sq. ft.	
Total equivalent heating surface	3,937.7 sq. ft.	5,766.3 sq. ft.	
Grate area	55.13 sq. ft.	70 sq. ft.	
Center of boiler above rail	9 ft. 10 in.	10 ft. 1 in.	
<i>Tender</i>			
Tank	Water bottom	Water bottom	
Wheels, diameter	36 in.	36 in.	
Journals, diameter and length	5 1/2 in. \times 10 in.	5 1/2 in. \times 10 in.	
Water capacity	7,000 gal.	7,000 gal.	
Coal capacity	12 1/2 tons	12 1/2 tons	

*Total equivalent heating surface = total evaporative heating surface + 1.5 times the superheater surface.

To BOSTON BY DAYLIGHT.—We understand that the Stonington & Providence Railroad is progressing rapidly. The route is a very level one, and one fourth of it, and that the most difficult, is already graded. It is expected that the road will be ready for use next season, when all who travel for pleasure will be enabled to leave New York in the morning in the Stonington steamboat, avoiding all the horrors of Point Judith and open sea navigation, and arrive at Boston in good time, by the Stonington and Providence and Boston and Providence Railroads, the same evening.—From *American Railroad Journal*, July 18, 1835.

IMPROVED TRANSPORTATION FACILITIES.—The new locomotive purchased for the use of the Lexington & Ohio Railroad Company was brought up to town on Wednesday, and will, we understand, be put in operation on the road in the course of a week. Since the railroad was opened to Frankfort, the passenger cars have been uniformly crowded both ways. Nothing is more common now than for a gentleman to take a morning ride to the seat of Government, spend several hours there in watching the movements of the Legislature, and return to Lexington again in the afternoon, without fatiguing himself, and with but a trifling call upon his purse. Heretofore, at this season of the year, the distance between Lexington and Frankfort has been considered a full day's journey on horseback, and the urgency of business alone could form a sufficient inducement to prevail upon a citizen to undertake it. When the locomotive is put upon the road, a single hour will suffice to accomplish the same distance, so that time, space and the worst obstacle to winter traveling, mud, will all be overcome.—Extract from the Lexington, Ky., Gazette, in the *American Railroad Journal*, January 24, 1835.

MAXIMUM PERMISSIBLE ERROR IN CRANK PIN LOCATION

BY O. V. P. BULLEID

Two errors may be present in the location of crank pins, that due to incorrect quartering, i. e., to the angle between the pins on the right and left hand sides of the engine being greater or less than 90 deg.; and that due to a difference in radii of the crank pin circles on the same side of the engine.

Error in the Angle Between the Crank Pins.—Referring to the diagram, Fig. 1, it is seen that the effect of an error in angle is doubled during each revolution, and that considered hori-

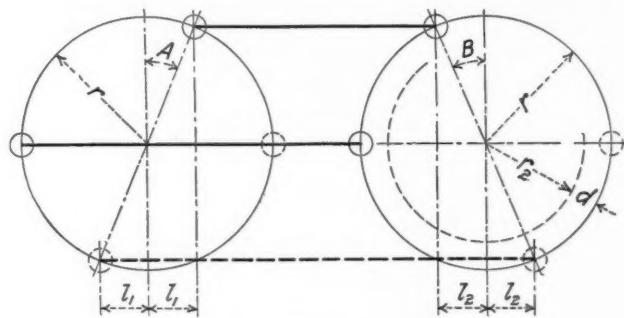


Fig. 1

A = error in angle in one pair of wheels.

B = error in angle in the other pair of wheels.

l_1 = effect of the angle A on the length of the rod.

l_2 = effect of the angle B on the length of the rod.

r = radius of the crank pin circle.

r_2 = radius of the other crank pin circle, the difference in radii being d .

zontally as it affects the side rod, the error $= l_1 + l_2$. But $l_1 = r \sin A$, and $l_2 = r \sin B$; therefore $l_1 + l_2 = 2r (\sin A + \sin B)$; or if $A_1 = A + B$, $l_1 + l_2 = 2r \sin A_1$, approximately. The clearances in the two bushings must be at least equal to this. If the clearance in one bushing be γ , $2\gamma = 2r \sin$

$$A_1, \text{ whence } \sin A_1 = \frac{\gamma}{r}.$$

The chart in Fig. 2 shows the maximum permissible total error in setting for two pairs of wheels for clearances of 1/64 in., 1/32 in., 1/16 in., and 3/32 in. As an example, with a crank pin of 13 1/2 in. throw, and a play of 1/32 in. in the side rod bushing the total error in the angle must not be more than 7.7

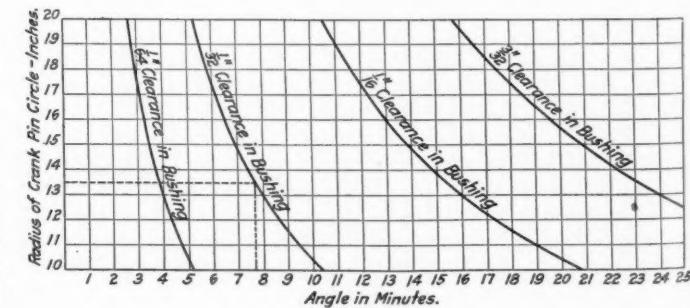


Fig. 2

minutes. The chart clearly shows the importance of extreme accuracy, and explains a cause of overheating which is not readily detected.

Error in Radii of Crank Pin Circles.—The effect of any difference of radii of the crank pin circles on one side of the engine on the length of the side rod is doubled during each revolution.

If d = the difference in radii, the effect on the side rod length $= 2d$. If the clearance in each bushing be γ as before, $2d$ must be less than 2γ , so that the maximum difference in radii must be less than the smallest clearance in any one bushing.

MODERN LOCOMOTIVE COALING STATION

The committee on Modern Locomotive Coaling Station, of the International Railway Fuel Association, in a report presented at the convention in May, decided that, as practically each railroad will have certain restrictive conditions that might prevent the adoption of any recommendations that might be made, it would serve the best interests of the association by submitting only such suggestions as might embody the best recommended practice for securing the highest true economies.

Location.—We would emphasize our former conclusions, revised as follows:

The committee recommends a very careful study of the character and source of the supply of fuel, and its possible future permanency, before locating any so-called permanent structures.

Where it can be accomplished without too great an expense, modern coaling stations should not be located at the large centers of population.

It might prove economical to locate coaling stations away from terminals a distance equal to that which can be covered by one locomotive tank supply.

Grade conditions, density and direction of traffic, loaded and empty car haul, junction point, location of supply, are all factors for careful consideration.

Design.—The committee feels that three types should cover the usual requirements and has confined its consideration to these three types.

Type One.—Gravity chutes, drop-bottom cars, handled up incline by locomotives or by oil, electric or steam power hoists.

Type Two.—Balanced buckets, using oil, steam or electric power; drop-bottom cars, coal dumped into pit and elevated by one to four balanced buckets, holding one to three tons each.

Type Three.—Bucket conveyor, using oil, steam or electric power; drop-bottom cars, coal dumped into pit and hoisted to main bins by small buckets on chain or link belt.

There are certain general features that should be embodied in the design of any of these three types, and the committee would make the following recommendations:

Breaker bars are deemed necessary and should be used until such times as the railroads may be able to arrange for the proper preparation of the size of the coal at the mines.

The track openings should always be so generously designed and provided as to fit the length and the width of the openings of the cars, and to prevent any clogging and to provide free and easy dumping.

The storage bins should be designed to permit of frequent cleaning and inspection. They should be divided by at least one partition and each subdivision should be furnished with several openings. All receptacles for coal should be designed to avoid the probability of any clogging in the corners. Warped surfaces ending at the openings will naturally destroy a certain amount of storage capacity, but should be given careful consideration. Whenever practicable, the point of delivery of the fuel to the bin should be directly above the opening of the discharge of the fuel to the tank.

If coal is easily fractured or powdered and whenever the fall is of considerable height, deflectors may be used to advantage, but they may be the cause of the fuel clogging.

The committee again calls attention to the necessity for providing warped surfaces or valleys at the angles of all storage bins and pockets, and this recommendation affects its suggestions in this connection. Naturally no fixed angle can be recommended to cover all classes of fuel, but it is believed that a slope of from 35 to 45 deg. will best serve in designing bins, pockets, hoppers, chutes and aprons.

All gates, doors, etc., should be designed to be freely opened and to the full size of the opening, to provide for the easy releasing and movement of the fuel.

The capacity of any coaling station is naturally dependent on the proper preparation of the fuel, the regularity of its supply and the frequent switching service of the road cars. Where these are normal and dependable, the committee recommends the following, with the understanding that it is not economical or desirable to hoist during the night hours:

TYPE ONE

For 24 hours' service for 10 locomotives.....	100 tons
For 24 hours' service for 25 locomotives.....	200 tons
For 24 hours' service for 50 locomotives.....	400 tons
For 24 hours' service for 100 locomotives.....	600 tons

TYPE TWO

For 24 hours' service for 10 locomotives.....	100 tons
For 24 hours' service for 25 locomotives.....	100 tons
For 24 hours' service for 50 locomotives.....	200 tons
For 24 hours' service for 100 locomotives.....	400 tons

TYPE THREE

For 24 hours' service for 10 locomotives.....	100 tons
For 24 hours' service for 25 locomotives.....	100 tons
For 24 hours' service for 50 locomotives.....	200 tons
For 24 hours' service for 100 locomotives.....	400 tons

The foregoing capacities are recommended, having in mind the necessity for filling the bins several times during the day, and stations should be designed to provide for hoisting capacities (minimum) as follows:

For 50-ton bin capacity.....	20 tons per hour
For 100-ton bin capacity.....	40 tons per hour
For 200-ton bin capacity.....	60 tons per hour
For 400-ton bin capacity.....	100 tons per hour

In regard to the construction the committee recommends reinforced concrete and steel construction as being first choice, but in any event steel should be used for all supports under bins and hoppers, and for the general structure. Whenever any of the storage parts come in contact with the fuel, they should be protected by reinforced concrete slabs.

The committee recommends that more care be used in the selecting of the men for operating the modern locomotive coaling station, and it believes that it would be economy to select men with sufficient mechanical experience to intelligently inspect and operate the plant, and to make running repairs thereto. A more careful inspection and operation would reduce maintenance costs and many running repairs would be made that now are expensive items, due to careless or ignorant operation.

Costs.—We have endeavored to secure actual figures to show costs for operating the different types of stations for the fiscal year ending June 30, 1913, but so few replies have been returned in answer to our inquiries, that an analysis of the subject is hardly possible. They indicate that there are as many methods used to secure figures as there are systems submitting them.

The report is signed by Hiram J. Slifer, chairman, E. A. Averill, E. E. Barrett, W. E. Dunham, G. W. Freeland, W. T. Krausch and R. A. Ogle.

DISCUSSION

If scales are to be used they should be thoroughly inspected often by competent scale inspectors, and if handled properly and carefully there is no question but that the shortages could be more accurately determined, but whether the information thus gained would warrant the expense of the scale was a matter which many were not quite sure of.

The angularity of the chute received considerable consideration, several members favoring a slope of over 50 deg. for run of mine coal as then there would be a more equal distribution of the lump and slack and it would be easier to clean out the chute. Mr. Crawford stated that no matter what slope the chutes have, they should all be cleaned frequently, the time between cleanings depending upon the grade of coal handled. On the Burlington some of the chutes are cleaned as often as every two weeks, twin bins being provided so that while one is being cleaned the other may be used for loading the locomotives. There should be no projections that will in any way interfere with drawing the coal direct from the bin, or allow the fine stuff to collect. Deflectors should be used where necessary to get a good, even distribution.

**TYPICAL EXAMPLES OF RECENT LOCOMOTIVES
ARRANGED IN ORDER OF TOTAL WEIGHT**

ARRANGED IN ORDER OF TOTAL WEIGHT

MIKADO TYPE

TYPICAL EXAMPLES OF RECENT LOCOMOTIVES

ARRANGED IN ORDER OF TOTAL WEIGHT

MALLETT, SANTA FE AND CONSOLIDATION TYPES

Puck-Jacobs low degree superheater. ¶ Locomotive Dictionary.

LOCOMOTIVE TOOL EQUIPMENT

BY C. T. ROMMEL

The keynote of present day railroad policy is economy, and one of the most fertile fields for improvement at present is in locomotive tool equipment and supplies. It is a common occurrence for the cost of tools to run as high as 54 cents a hundred miles, and it is possible, with proper supervision of designs, etc., to reduce this cost to as low as 15 cents a hundred miles. On one of the trunk lines the cost of locomotive tools and supplies runs as high as \$300,000 a year if it is not followed closely, but by giving this matter the necessary attention it will be possible to reduce it to \$70,000 a year, or a net saving of \$230,000 a year.

One of the first steps toward reducing this expense to a mini-

FORM 1.
A. B. C. RAILROAD COMPANY.
LOCOMOTIVE TOOL EQUIPMENT AND SUPPLY LIST.

	Service.		
	Pass.	Freight.	Switch-ing.
Engine oiler	1	1	1
Torch	1	1	1
Valve oil can, 1½ pints....	1	1	0
Engine oil can, 3 pints....	1	1	0
Carbon oil can, 4 pints....	1	1	0
Signal oil can, 1 pint....	1	1	0
Valve stem clamp.....	1	1	0
Screw wrench—12 in.....	1	1	1
Screw wrench—15 in.....	1	1	1
Hand hammer	1	1	1
Flat chisel	1	1	1
Air pump spanner wrench..	1	1	1
Rerailers	2	2	0
Push pole	0	1	1
Shaker bar	1	1	1
Broom	1	1	1
Scoop shovel	1	1	1
Coal pick	1	1	1
Water bucket	1	1	1
Hoe or hook (either but not both)	1	1	1
Poker	1	1	1
Water cooler or jug (either but not both)	1	1	1
Drinking cup	1	1	1
Gage lamp	1	1	1
Water gage glass lamp.....	1	1	1
Front classification lamps..	2	2	2
Rear marker lamps.....	2	2	0
White lanterns	1	1	1
Red lanterns	1	1	1
White flags	2	2	2
Green flags	4	4	4
Red flags	1	1	1
Torpedoes	6	6	6
Red fuses	4	4	0
Only where required.			
{ An extra second hand shovel where required.			
Where required.			
Where required.			
Where required.			
2 where required.			

mum is to carefully revise the tool and supply equipment list so that no tools are carried unless absolutely necessary, and the amount of supplies carried is reduced to a minimum. After the list has been brought up to its highest point of efficiency, the de-

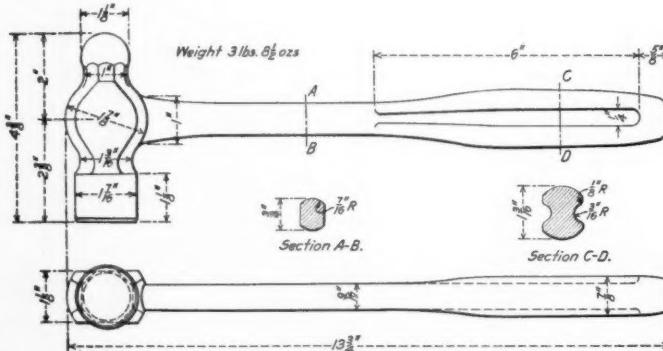


Fig. 1—All Steel Hammer

signs of the tools used should be examined and made as simple and as cheap as possible, considering the requirements. A very good way to take up the question of design is to make a careful

examination of the tools in use and note where they have been failing and to change the design to strengthen the particular tool at the point of failure. After this has been done the tool equipment and supplies should be checked and so arranged as to give the best results. A very good way is to get together all of those concerned and thoroughly discuss the question, obtaining the views of master mechanics, road foremen, assistant road fore-

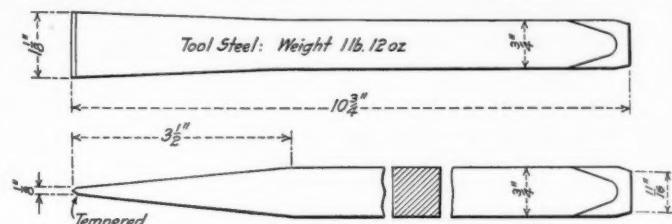


Fig. 2—Chisel Made of Square Steel

men and representative engineers and firemen. The operating conditions should also be very carefully investigated, as it will be found impossible on some divisions to get along with the same amount of tools and supplies as on others.

Form 1 will answer the purpose very well for a locomotive tool equipment and supply list. On this, only such tools as are

FORM 2.

A. B. C. RAILROAD COMPANY.
TOOL INSPECTOR'S DAILY REPORT OF TOOLS MISSING
ON ARRIVAL OF LOCOMOTIVES.

Jonesville Station.
John Doe, Inspector.

Date, January 28, 1913.
From 6:00 A. M.
To 6:00 P. M.

Engine No.	Engineer.	Terminal Despatched	Time	Tools
		From.	Checked.	Missing.
1000	S. Clark	Cameron	6:30 A. M.	1 broom
875	J. True	Kent	6:40 A. M.	1 12 in. wrench
.....
.....

FORM 3.

A. B. C. RAILROAD COMPANY.
TOOL AND SUPPLY CLEARANCE TICKET.

Engine No. Despatched from.....

with following tools not on engine.....

Date..... Roundhouse Foreman.
Time.....

absolutely necessary are carried on the locomotive and, as in the case of the oil cans, these are to be carried only on locomotives where the mileage is greater than can be taken care of by one supply of oil. Push poles are to be carried only when required,

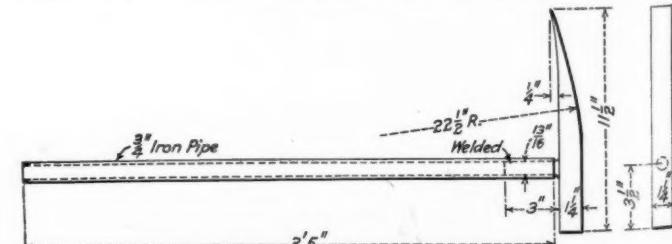


Fig. 3—Coal Pick with a Handle Made of Pipe

and it is preferable that they be located at points where they are to be used; by so doing the number required will be greatly reduced. The hoe or hook is to be used only where the fuel

is such that they are required. With some kinds of fuel it will not be necessary to use either. Front classification lamps and

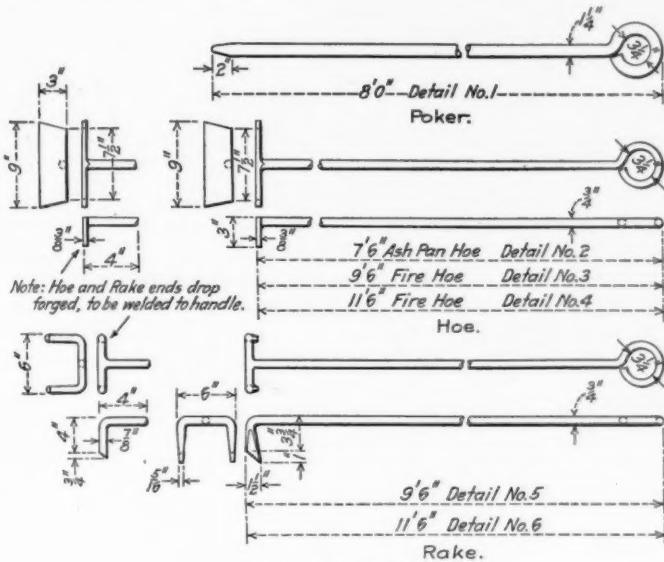


Fig. 4—Firing Tools

white flags are to be used only when required, and this also applies to the number of green flags.

As each locomotive is placed in service when new, or after

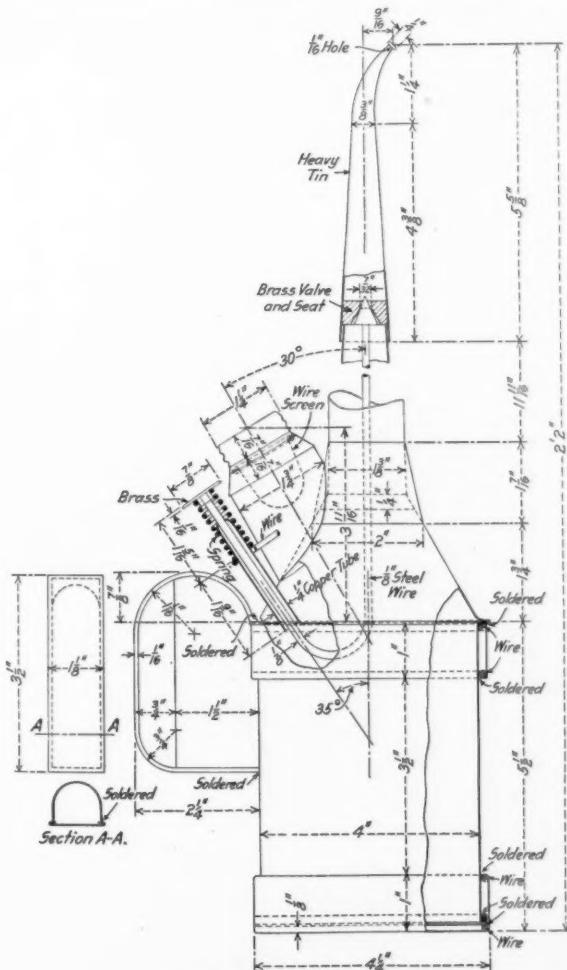


Fig. 5—Engineer's Oil Can

receiving heavy repairs, the tool equipment and supply list should be checked over with form 1 and any items found missing should be replaced. On arrival at each terminal, the tool inspector should fill out form 2 showing any items missing

from the locomotive. In order to simplify investigation as to the cause of missing tools and to settle any question of veracity which may arise between the engine crew and the tool supply man, form 3 should be used. If, in case of missing tools, the

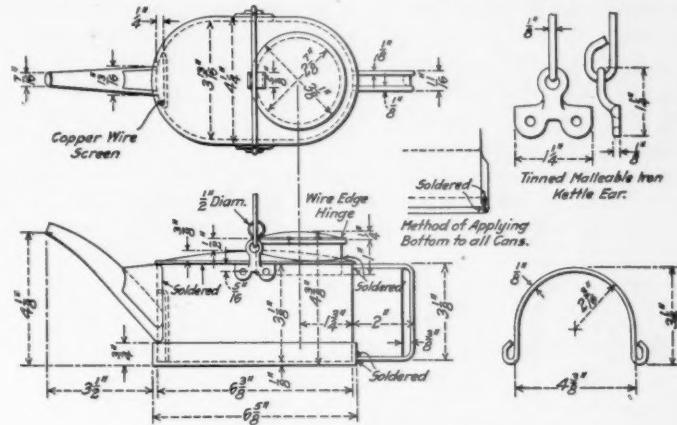


Fig. 6—Extra Valve Oil Can

engine crew cannot hand over form 3 properly filled out, it will be very evident that the tools were either lost or broken after the engine was in the crew's hands.

As to the method which should be followed in checking the

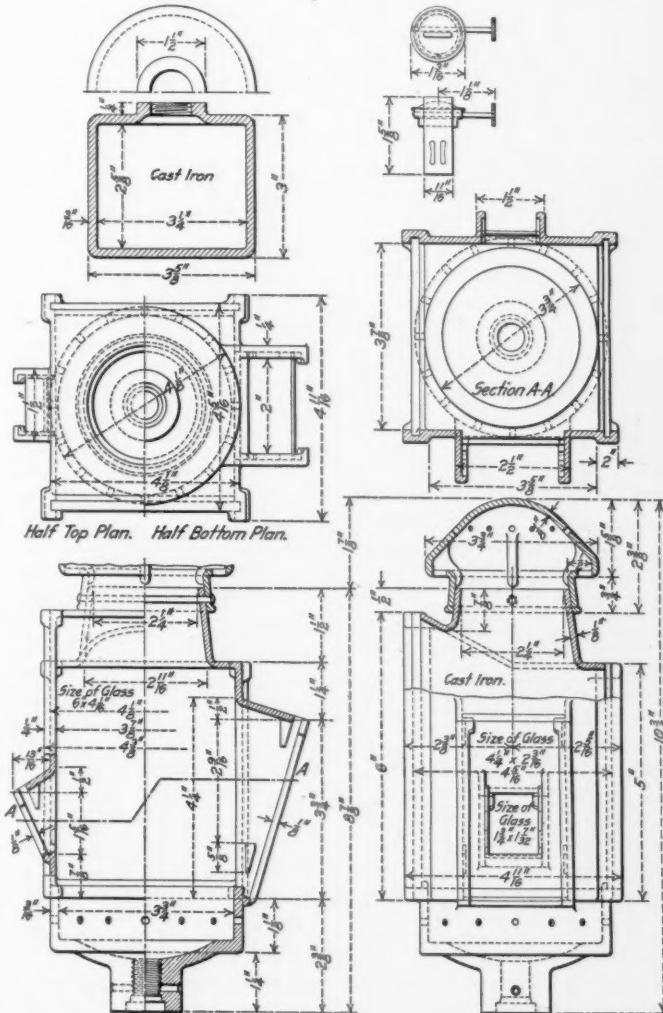


Fig. 7—Cab Lamp for Pressure Gages

tools by the inspector before filling out form 2, the best results can be obtained by making this out on the arrival of the locomotive at the terminal. After the tools have been checked and placed in the boxes provided for them, the boxes should be

sealed, and on the departure of the locomotive if the seal is not broken, a second check will not be necessary. If it should be found broken it will be evident that the tools were used and an investigation as to why it was broken will be confined to the terminal only, which will save time in investigating. A car seal can be used instead of a lock, as, if anyone desires to open the tool box, they will just as quickly break the lock as they would the car seal, and the difference in the price warrants the use of the seal. When the inspector makes his check of the tools and supplies, if he finds any damaged or broken he should have them repaired if possible, or if it is impossible to repair them, new ones should be drawn and the cause of their being drawn shown on the order to the store house. All orders for new locomotives

designs of locomotive tools suitable for the use for which they are intended and unsuitable for the use of shop men or train men. When the cost of locomotive tools runs very high, especially in regard to the number of hammers, chisels, screw wrenches, torches and lanterns used, investigation will show that these different tools and supplies are being furnished to the locomotives, but instead of remaining on the locomotives as was intended, are being taken and hoarded by shop men and train men. On this account the tools should be so designed that the shop men will not like them, and lanterns should be so designed that they will not be popular with the train men. Tools which fail too quickly should be designed to overcome these failures, as for instance, coal picks and oil cans. Investigation shows that on a number

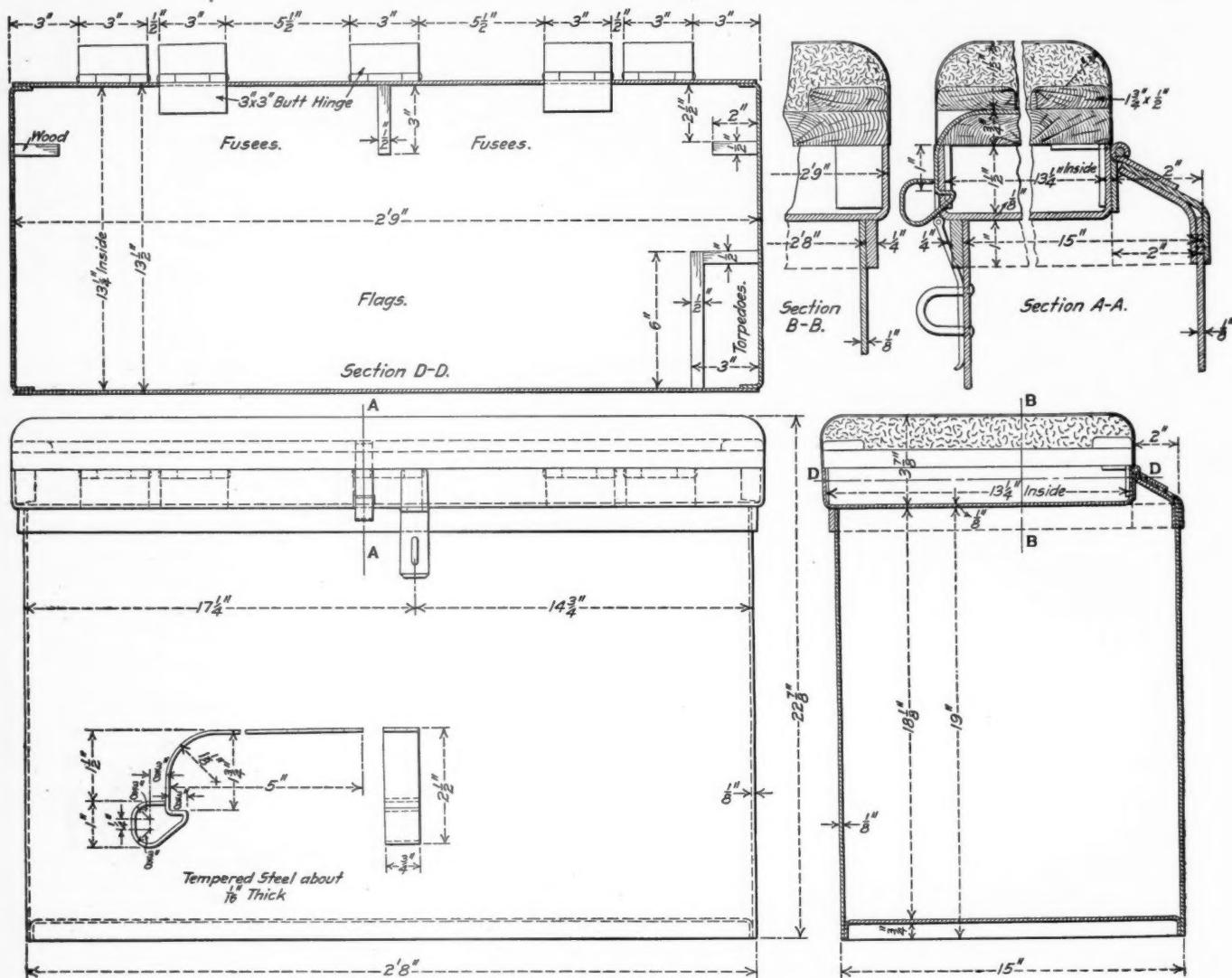


Fig. 8—Cab Seat Box with Receptacle for Fusees and Flags

tive tools should be approved by someone designated for that purpose, and these orders should also be gone over by the official in charge of the terminal, who will thus keep in touch with the situation and thereby be in a position to follow up closely any unusual demand for certain tools, the cause for which may be either poor design or improper handling. A place should be set apart for the tool and supply men, and should be fitted up with the necessary facilities for making minor repairs so that the men could be kept busy on such work when not otherwise engaged. Any repairs which could not be done by them would be taken care of by other means, and after the tools are repaired and returned to the tool and supply men they could be placed in bins assigned to them.

A large reduction in expenditure can be made by making the

of coal picks lost the head of the pick causes no trouble, but when a wooden handle is used, it breaks off and the engine crews, instead of bringing the head of the pick to the terminal for a new handle, very often throw it off on the right of way. With the engineers' oil cans it will be found that the greatest trouble is that the end of the spout is turned off and, when this trouble occurs the engineers very often throw the cans off the engine.

The designs of tools illustrated have been worked up to overcome these troubles. The all-steel hammer shown in Fig. 1 takes the place of a hammer with a wooden handle. This hammer is made in a forging machine from old knuckle pins at a cost of nine cents; the hammer which it replaces cost about 25 cents ready for use. This hammer will not be popular with shop men on account of the steel handle.

The chisel shown in Fig. 2 is made of $\frac{3}{4}$ in. square steel. The chisel previously furnished was made of hexagon steel the same as that furnished the shop men, and a large number of the chisels placed on locomotives eventually found their way to the lockers of the shop men. The square chisel, if used by the shop men will have a tendency to cut their hands, and will therefore eliminate the taking of chisels from locomotives.

The coal pick shown in Fig. 3, the head of which is made in a forging machine and to which a $\frac{3}{4}$ in. iron pipe handle is welded, will overcome the trouble with broken handles. The fire tools shown in Fig. 4 have the ends made in a forging machine and the handles are welded to them. This process of manufacture reduces the original cost and increases the life of the tool. The engineer's oil can shown in Fig. 5 was designed after investigation showed that the spout formerly used was too long and the length of the spout shown was decided upon after examination of a number of oilers on which the spouts had failed. The capacity of the can is made so that it will hold the largest supply of engine oil furnished on the system; the necessity for carrying an addi-

use a cab lamp for the water gage, the cast iron design shown in Fig. 9 is used. This lamp is in one piece, the fount being a part of the body. White and red lanterns should be of such a design that the danger of breaking the globes is reduced to a minimum and of such a shape that they will not be convenient for train men's use.

The receptacle for fuses, flags and torpedoes should be so designed that there is no possibility of their becoming wet, and at the same time they should be within convenient reach. A very good receptacle for these supplies is illustrated in the cab seat box shown in Fig. 8. This has a compartment under the seat for this purpose. The tender tank tool boxes should be conveniently fitted with trays or shelves for the storing of tools. When the locomotive is at a terminal or is placed in the shop for repairs, all tools and supplies should be removed and placed in the store or supply room provided for this purpose. Hostlers should each be furnished with a shovel, which they can retain for shop purposes.

When a system such as that described has been installed and is in good working order, it will do away with the practice of running the locomotive tool and supply list on the plan of "first in first out," that is, removing the tools of a locomotive just coming in to one just going out, which requires a considerable amount of time on the part of the tool supply men, and very often results in an unnecessary terminal delay. The time thus saved by the supply men can be used to good advantage in making minor repairs to such tools as need them.

ECONOMIES IN ROUNDHOUSE AND TERMINAL FUEL CONSUMPTION

The following is from a paper by F. W. Foltz, fuel supervisor, Missouri Pacific, read at the convention of the International Railway Fuel Association, May 18-22, 1914:

Investigation develops that from 15 to 25 per cent of the total coal used by locomotives is consumed in roundhouses and at terminals while they are not actually performing service. Engine crews should be taught to bring their engines to the cinder pit, at the completion of each trip, with a thin fire, the boiler full of water and nearly full steam pressure. As far as practical the fire should be allowed to burn lowest at the back end of the firebox, as the fire cleaner drops the back dump grate first. The fireman, before leaving his engine, should throw two or three shovelfuls of coal into the forward end of the firebox, to act as a protection to the flues.

Locomotives should receive immediate attention on arrival at the terminals. In cleaning the fire any unburned coal should be pushed ahead, the back section of the grates shaken, then the dump grate dropped and any clinkers pulled back and forced through the dump. After this operation, the grates should be leveled and the dump grate closed. If the engine is to lie over several hours, the fire should be pushed ahead, leaving the dump and one or two grates bare, then covered over as the condition of the fire warrants, but in all cases sufficiently to prevent the pops opening. When the engine is ordered, the fire should not be broken up until shortly before leaving time, unless it is necessary on account of a poor fire. The excessive use of the blower should be guarded against at all times and especially when cleaning the fire.

Too great care cannot be given at terminals to the proper cleaning of flue sheets and flues. This applies more especially to our superheated engines. Roundhouse foremen should give this work particular attention, instruct the men and provide proper tools for the work, and I would suggest that a cent or two more an hour be paid for this work as an incentive for better service. The proper washing and cleaning of boilers at terminals is one of our greatest factors in fuel economy.

Material saving can be made in firing up locomotives at

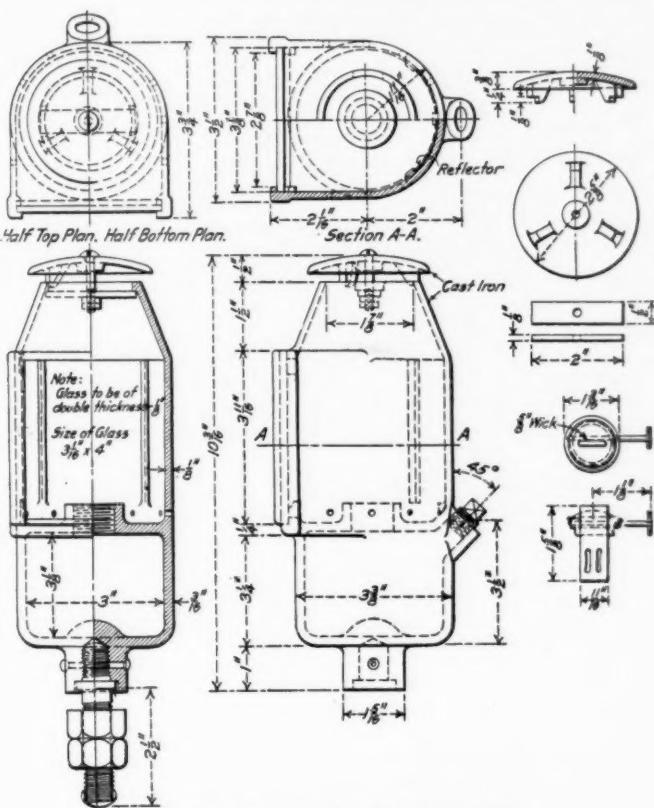


Fig. 9—Car Lamp for the Water Gage

tional supply can for engine oil is thus avoided. The can is very substantially made and has a thumb trigger for operating the valve, which is located on the right side of the handle rather than in the center, as it develops that by placing it in this position the engineers are better able to operate the valve and the loss of oil is consequently reduced to a minimum.

The extra valve oil supply can shown in Fig. 6, which is to be used only when it is necessary to carry a double supply on the engine, is made of such capacity that it will hold one supply only, the second supply being placed in the lubricator. The spout on this can is so designed that it is possible to fill the lubricator without any loss of oil, this shape being decided upon after considerable experimenting. The can is of such shape that it does not take up much room, which is an important consideration in storing cans when not in use. The cab lamp for pressure gages shown in Fig. 7 is made of cast iron and takes the place of the sheet iron lamp formerly used. This design, on account of its increased strength, has reduced very considerably the number of cab lamps furnished for this purpose. Where it is necessary to

terminals. I have found at many terminals where they were bedding down grates, using 90 scoops of coal (where shavings were used to start the fire), but after carefully instructing the fire-builder and following it up to see that our instructions were carried out, we were able to get the same results from 40 to 50 scoops of coal. Where shavings are used for starting fires in engines in roundhouses, ash pans should be left open and coal that has fallen through the grates can be picked up from the pit in a wheelbarrow and taken to the stationary plant for fuel. In preparing the fire for service the blower should be used gently so that the fire will burn slowly and the rise of steam pressure will not be too rapid. The sudden expansion of sheets and tubes may result in harm.

In order that the amount of time locomotives are kept under steam, when not performing service, may be reduced to the minimum, a daily report from each terminal will be found of great value. It is also desirable to charge each terminal with the amount of coal consumed by locomotives from the time they are turned over to the hostlers until they are again placed in charge of the road crews.

The coal consumed by stationary boilers is also a feature that has received very little attention on most roads. The inexperienced, cheap laborer usually employed to heave the coal into the firebox of the stationary boiler is one of the most expensive small units in a railroad organization.

DISCUSSION

Many members laid particular stress on the opportunities for wasting fuel at terminals, and have shown by tests that from 20 to 35 per cent of all the fuel used on locomotives is used at terminals. On investigation some have found that the absolute waste in fuel at terminals is as high as 50 per cent, and that on examination of the ash pits as high as 35 to 50 per cent fixed carbon in the ash has been found. Considerable was said concerning economy at stationary plants. It was believed that if more intelligent firemen were used in this work considerable saving could be made.

Robert Collett, formerly with the Frisco, showed how a good deal of the fuel used at terminals was saved by doubling the length of trips of the locomotives. By careful instructions to the firemen they can so handle their fires that it will not be necessary to perform the cleaning usually made every hundred miles or so. The Frisco now successfully operates one locomotive over a division of 240 miles. Mr. Foltz stated that on four heavy runs between Kansas City and St. Louis that road had saved \$1,000 per month by running their engines through.

The Chesapeake & Ohio are using shavings without oil for starting fires, and find that it provides a much slower burning fire, which gives the coal a much better chance of igniting. It was generally conceded that this practice was good where the shavings were such that they could be used in this way. For mixed shavings containing a lot of sawdust it is necessary to use some fuel oil. One member expressed the opinion that it was much better to use 1,000 or 1,200 lb. of coal in firing up instead of a smaller amount, for otherwise there will be considerable shaking of grates during the time the engine is standing and considerable coal will be fired that would not ordinarily have to be. Special attention was called to the necessity of leaving ash pans open when fires were being built, so that the coal falling through the grate will fall into the pit and not clinker up the ash pan opening. Mr. Bentley, of the Northwestern, believed there were great opportunities of conserving the heat of locomotives by covering the stack while in the roundhouse.

SERVIA AND THE ORIENTAL RAILWAY.—The Servian government has resolved to build a line parallel to the Oriental Railway in case it cannot come to an understanding with Austria-Hungary with reference to the latter.

ELLIPTIC SPRING TABLES.

BY ANTHONY SCHMIDT

Leading Locomotive Draftsman, Kansas City Southern, Pittsburg, Kan.

The accompanying table gives the capacity for different thicknesses of plate one inch wide, and is for use in calculating semi-elliptic springs.

To obtain the required number of plates, multiply the figure given in the load column by the width of the spring in inches and divide the required capacity by the result. The quotient gives the number of plates required.

Where the quotient gives a decimal greater than three, add one plate to the whole number. The number of full length plates must be 25 per cent of the whole number required; the other plates must be regularly shortened. The deflection given in the table is the difference between the free and loaded height, irrespective of the width or number of plates. The deflection given is that under static load plus 30 per cent of the deflection for permanent set of the spring. The calculations in the table are based on a working fiber stress of 75,000 lb., and a modulus of elasticity of 27,000,000. The following formulas are used:

$$P = \text{Net static load};$$

$$F = \text{Deflection};$$

$$H = \text{Thickness of plate};$$

$$L = \text{Length between centers; then}$$

$$50,000 H^2$$

$$P = \frac{50,000 H^2}{L}, \text{ and}$$

$$F = .000595 \frac{L^2}{H}$$

One Plate 1 in. Wide						
Length between centers, inches	1/4 in. Plate		5/16 in. Plate		3/8 in. Plate	
	Load	Deflection	Load	Deflection	Load	Deflection
20	156	.952	244	.7616	.....	.....
21	149	1.050	232.5	.8396	.....	.....
22	142	1.152	222	.9215	319.5	.7680
23	136	1.259	212.5	1.007	305.5	.8394
24	130	1.371	203.5	1.097	293	.9139
25	125	1.487	195.5	1.190	281	.9917
26	120	1.608	188	1.287	270.5	1.073
27	115.5	1.734	181	1.388	260.5	1.157
28	111.5	1.866	174.5	1.493	251	1.244
29	108	2.002	168.5	1.601	242.5	1.334
30	104	2.142	163	1.714	234.5	1.428
31	.....	157.5	1.830	227	1.525	308.5
32	.....	152.5	1.950	219.5	1.625	299
33	.....	148	2.073	213	1.728	290
34	.....	143.5	2.201	207	1.834	281.5
35	.....	139.5	2.332	201	1.944	273
36	.....	135.5	2.468	195.5	2.056	266
37	.....	131.5	2.604	190	2.172	258.5
38	.....	127.5	2.739	185	2.291	252
39	.....	123.5	2.874	180.5	2.413	245.5
40	.....	119.5	3.009	175.5	2.539	239
41	.....	115.5	3.144	171.5	2.667	233.5
42	.....	111.5	3.279	167.5	2.799	228
43	.....	107.5	3.414	163.5	2.934	222.5
44	.....	103.5	3.549	160	3.071	217.5
45	.....	99.5	3.684	156	3.213	212.5
46	.....	95.5	3.819	153	3.357	208
47	.....	91.5	3.954	149.5	3.505	203.5
48	.....	87.5	4.089	146.5	3.656	199.5
49	.....	83.5	4.224	143.5	3.800	195.5
50	.....	79.5	4.359	140.5	3.944	191.5
51	.....	75.5	4.494	137.5	4.077	187.5
52	.....	71.5	4.629	134.5	4.211	184
53	.....	67.5	4.764	131.5	4.345	180.5
54	.....	63.5	4.898	128.5	4.479	177
55	.....	59.5	5.033	125.5	4.613	.....
56	.....	55.5	5.167	122.5	4.747	.....
57	.....	51.5	5.301	119.5	4.881	223
58	.....	47.5	5.435	116.5	4.915	219.5
						215.5

THE SAFETY APPLIANCE ACT.—During the fiscal year ended June 30, 1913, 191 cases, involving an aggregate of 626 violations of the safety appliance act, were transmitted to the several United States attorneys for prosecution. Cases comprising 91 counts were tried in court, of which 56 counts were decided in favor of the Government. Of the remaining 35 counts originally decided in favor of defendants, appeals have been taken by the Government as to 31. The carriers confessed judgment during the year as to 448 counts. Penalties aggregating \$56,800 were collected, and additional penalties in the sum of \$19,800, in addition to costs previously assessed by the courts, were, on July 1, 1913, pending payment by the carriers.

ROLLING STOCK ON CURVES

BY ALBERT R. TEGGE*

The swing of a locomotive truck on a curve is determined by a simple computation, but in determining the swing of a locomotive or car coupler, or the clearances required, the usual method is to draw, to a convenient scale, the locomotive or car on a curve of the required radius. From this drawing the necessary information is scaled.

This is a tedious and unnecessary process, and while it answers the purpose in the drawing room, it is obviously impracticable for the salesman in the field and too slow for a rapid and accurate determination.

It is the purpose of this article to give the formulas required

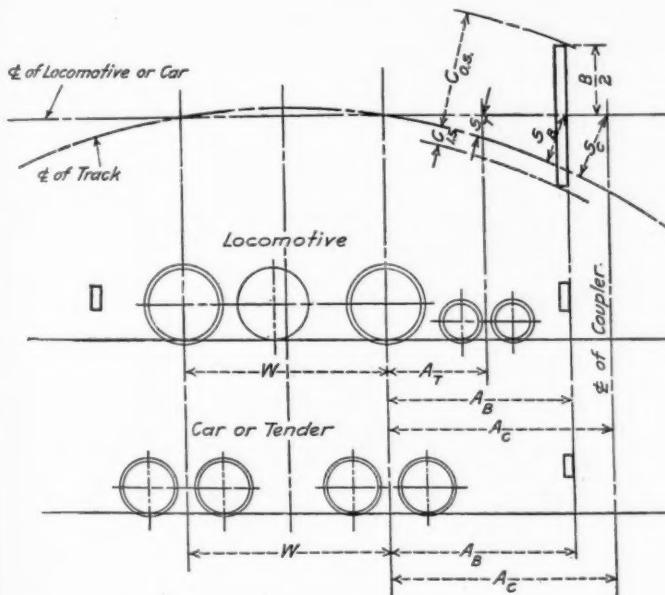


Fig. 1

for finding the swing of couplers, trucks and bumpers, also formulas for outside and inside clearances.

In the following formulas,

R = radius of the curve.

g = amount of gage increase on the curve.

W = rigid wheel base of the locomotive or the distance between the truck centers on cars or tenders.

The other letters are shown on the diagrams.

$$d = \sqrt{R^2 - \left(\frac{W}{2}\right)^2}$$

$$c = \frac{A(A+W)}{2A+W}$$

$$a = \frac{W}{2} + A - c$$

For the swing of a four-wheel locomotive truck (Fig. 1).

$$S_T = \sqrt{R^2 - \left(\frac{W}{2}\right)^2 + \left(\frac{W}{2} + A_T\right)^2} - R + \left(g \frac{W + A_T}{W} - g\right)$$

For the swing of a locomotive or car coupler (Fig. 1):

$$S_C = \sqrt{R^2 - \left(\frac{W}{2}\right)^2 + \left(\frac{W}{2} + A_C\right)^2} - R + \left(g \frac{W + A_C}{W} - g\right)$$

For the swing of locomotive or car bumpers (Fig. 1):

$$S_B = \sqrt{R^2 - \left(\frac{W}{2}\right)^2 + \left(\frac{W}{2} + A_B\right)^2} - R + \left(g \frac{W + A_B}{W} - g\right)$$

Maximum inside clearance required (Fig. 1):

$$\begin{aligned} C.I.S. &= R - \sqrt{R^2 - \left(\frac{W}{2}\right)^2} + \frac{B}{2} + \frac{g}{2} \\ &= R - d + \frac{B}{2} + \frac{g}{2} \end{aligned}$$

Maximum outside clearance required (Fig. 1):

$$C.O.S. = \sqrt{\left(d + \frac{B}{2}\right)^2 + \left(\frac{W}{2} + A_B\right)^2} + g \frac{W + A_B}{W} - \frac{g}{2} - R$$

$$C.O.S. = S_B + \frac{B}{2} \text{ (approximately).}$$

The distances from the front or rear bumper to the front or rear driver (A_B) are usually not equal. Therefore, in computing the maximum outside clearance both ends must be considered.

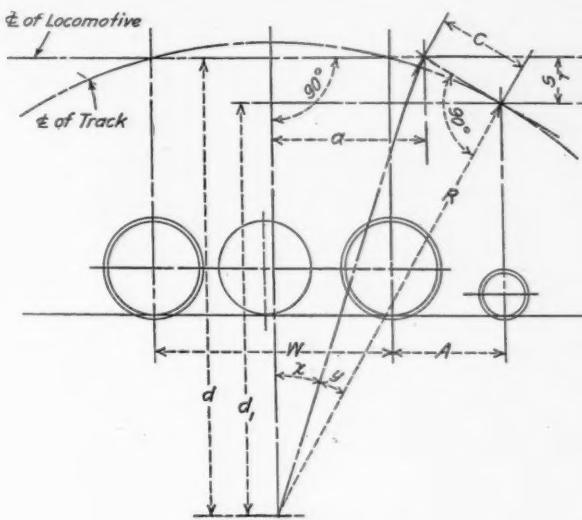


Fig. 2

For the swing of a two-wheel locomotive truck (Fig. 2):

$$S_T = d - d_1 + g \frac{W + A_T}{W} - g$$

$$d_1 = R \cos(x+y)$$

$$\cos(x+y) = \cos x \cos y - \sin x \sin y$$

$$= \frac{d}{\sqrt{d^2+a^2}} \times \frac{R}{\sqrt{R^2+c^2}} - \frac{a}{\sqrt{d^2+a^2}} \times \frac{c}{\sqrt{R^2+c^2}}$$

$$\text{Remembering that } \sqrt{d^2+a^2} = \sqrt{R^2+c^2}$$

$$\cos(x+y) = \frac{dR - ac}{R^2 + c^2}$$

$$\text{then } d_1 = \frac{R(dR - ac)}{R^2 + c^2}$$

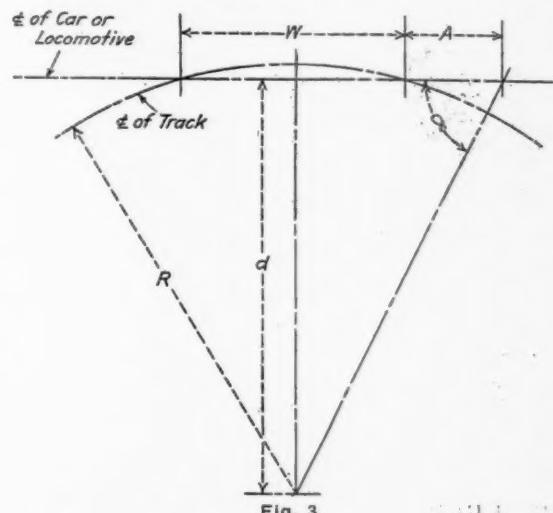


Fig. 3

$$= \frac{dR^2 - Rac}{R^2 + c^2}$$

$$d - d_1 = d - \frac{dR^2 - Rac}{R^2 + c^2}$$

$$= \frac{dR^2 + dc^2 - dR^2 - Rac}{R^2 + c^2}$$

$$\text{Therefore } d - d_1 = \frac{dc^2 - R ac}{R^2 + c^2}$$

$$S_T = \frac{dc^2 - R ac}{R^2 + c^2} + \left(g \frac{W + A}{W} - g \right)$$

The angle α is an important angle (Fig. 3).

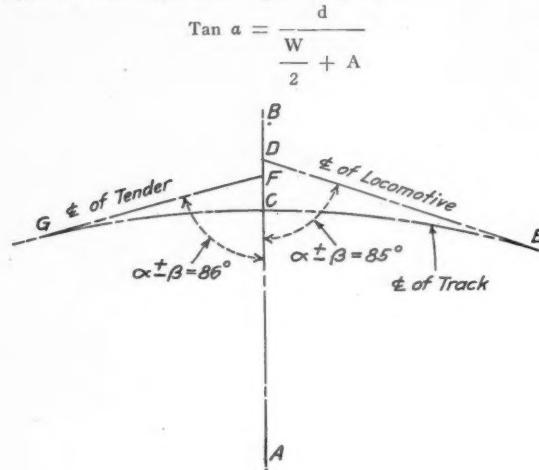


Fig. 4

To α must be added $\pm \beta$ (the angle due to the increase of gage).

$$\tan \beta = \frac{\frac{g}{2}}{\frac{W}{2}} = \frac{g}{W}$$

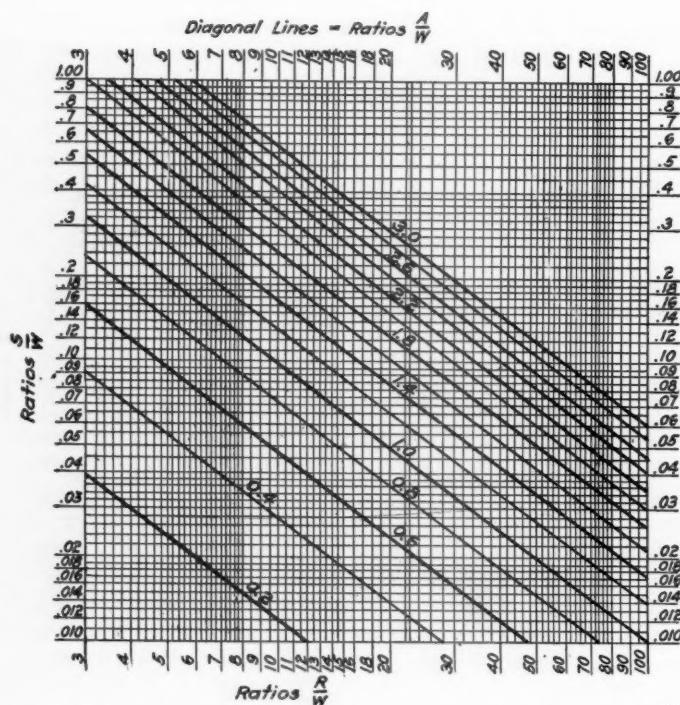


Fig. 5

Having determined the respective values of S_c and $\alpha \pm \beta$ for a locomotive and tender (or two cars), it is then possible to draw the locomotive and tender in their proper relation to each other without first laying down the curve. To illustrate:

$S_c = 6$ in., $\alpha \pm \beta = 85$ deg. for the locomotive.
 $S_c = 4$ in., $\alpha \pm \beta = 86$ deg. for the tender.

Draw AB (Fig. 4) and let the point C be the center line of the track.

Lay off $CD = 6$ in. (to scale) and at D make the angle $CDE = 85$ deg. (to the right of AB).

Lay off $CF = 4$ in. and at F make the angle $CFG = 86$ deg. (to the left of AB).

Then DE will be the center line of the locomotive and FG the

center line of the tender. The chasing plate, wedge, bumpers drawbar, drawbar pocket, cab apron, etc., can then be drawn in to determine the proper clearances.

In the preceding formulas plus and minus values have been given to β and $g \frac{W + A}{W}$. These signs are obtained as follows:

When the front driver of a locomotive is pressed against the outside rail and the rear driver against the inside rail we have $+ g \frac{W + A}{W}$ and $- \beta$ for the front end; and $- g \frac{W + A}{W}$ and $+ \beta$ for the rear end.

With the front driver against the inside of the rail and the rear driver against the outside of the rail, $+ g \frac{W + A}{W}$ and $- \beta$ should be used for the rear end, $- g \frac{W + A}{W}$ and $+ \beta$ for the front end.

The diagram (Fig. 5) is based on the formula

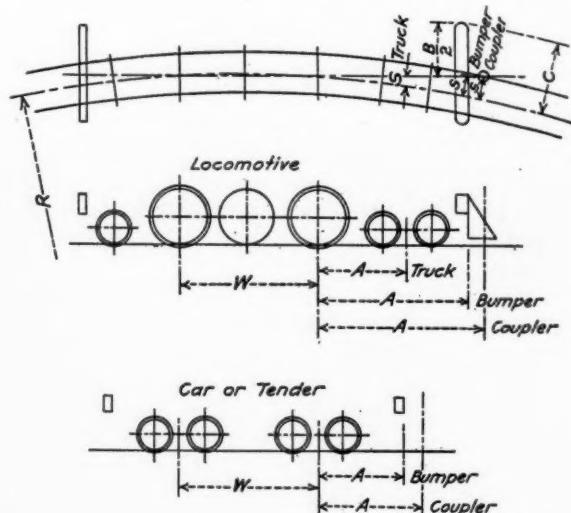
$$S = \sqrt{R^2 - \left(\frac{W}{2}\right)^2 + \left(\frac{W}{2} + A\right)^2} - R$$

and has been devised as an approximate and rapid solution of the swing and clearance problems. The use of the diagram can best be illustrated by an example.

Given a rigid wheelbase, $W = 10$ ft.; radius of curve, $R = 100$ ft.; front driver to front bumper, $A = 6$ ft.; width over bumper, $B = 108$ in.

Required to find the swing of the bumper and outside clearance:

$$\frac{R}{W} = \frac{100}{10} = 10$$



For Swing (S) of Truck, Bumper or Coupler: Find Ratios $\frac{R}{W}$ and $\frac{A}{W}$. On horizontal at intersection of vertical $\frac{R}{W}$ and diagonal $\frac{A}{W}$, find $\frac{S}{W}$. Then $S \times W = S$. For outside clearance (C) find swing (S) of Bumper. Then $C = S + \frac{B}{2}$

Based on formula $S = \sqrt{R^2 - \left(\frac{W}{2}\right)^2 + \left(\frac{W}{2} + A\right)^2} - R$.

$$\frac{A}{W} = \frac{6}{10} = 0.6$$

On the horizontal at the intersection of the vertical $\frac{R}{W} = 10$ and the diagonal $\frac{A}{W} = 0.6$ read $\frac{S}{W} = 0.047$.

Then the swing of the bumper,

$$S = \frac{S}{W} \times W = 0.047 \times 10 = 0.47 \text{ ft.}$$

$$0.47 \times 12 = 5.65 \text{ in. (swing in inches).}$$

Outside clearance required,

$$C = S + \frac{B}{2} = 5.65 \text{ in.} + \frac{108 \text{ in.}}{2} = 5.65 + 54 = 59.65 \text{ in.}$$

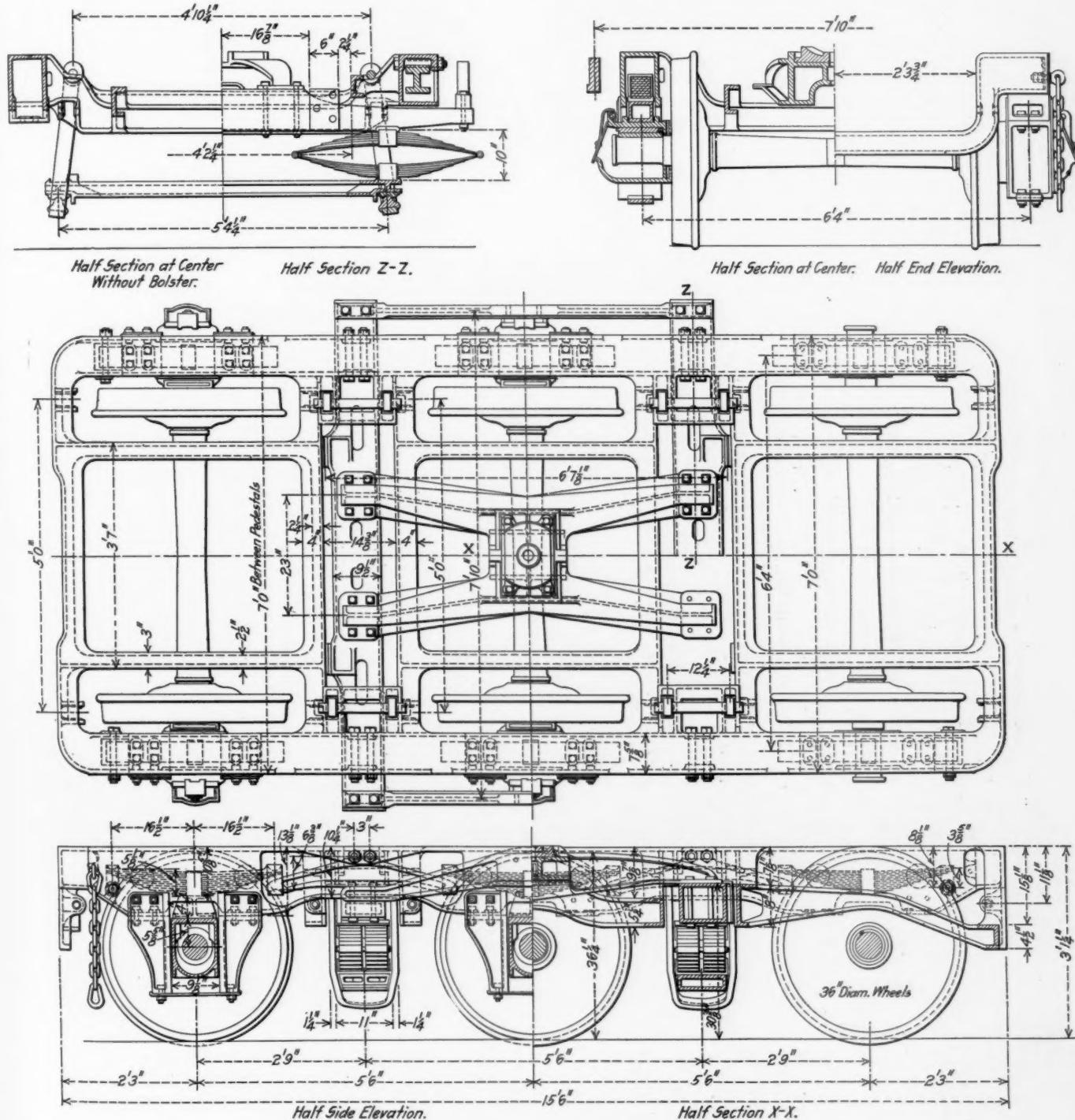
CAR DEPARTMENT

STEEL TRUCK WITH CLASP BRAKE RIGGING

The New York Central is now using on steel passenger train cars a type of six-wheel truck which was designed especially for the use of clasp brakes. The truck is of all-steel construction

almost, if not quite, impossible because of the difficulty of removing and replacing the brake shoes. With the ordinary arrangement of equalizers the shoes of the clasp brakes would be directly behind them, making the work of removing and replacing shoes extremely difficult.

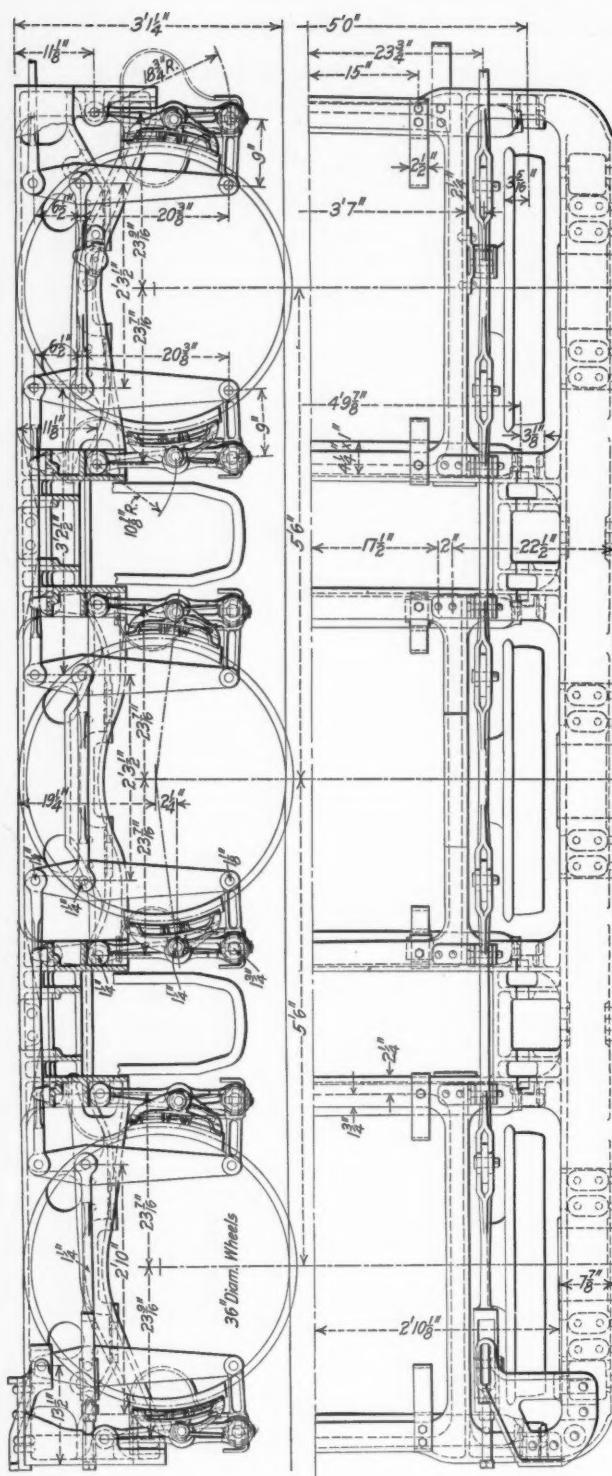
In the New York Central truck the equalizers are placed be-



General Arrangement of New York Central Six-Wheel Steel Truck

and the principal feature is the arrangement of the equalizers. The use of the clasp brake arrangement with the system of equalization commonly used on six-wheel passenger trucks is

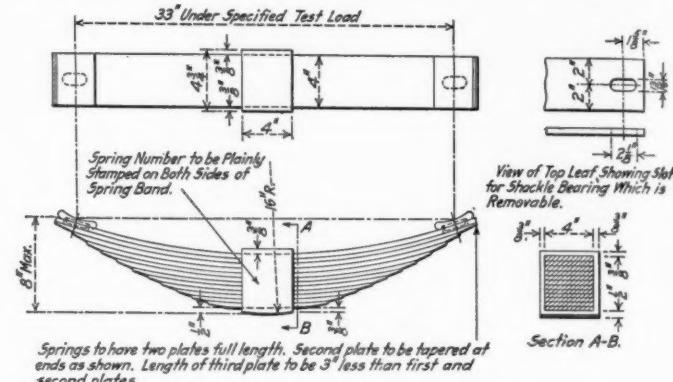
tween the wheels and have fulcrums in the truck frame. It will be noted that the fulcrums have two point bearings. This arrangement was used with the idea that when the equalizer



Partial Plan and Sections Showing the Clasp Brake Used on the New York Central Truck

tilted it would rest only on one of the bearings and the lever arm tending to pull it back into neutral position would be longer than the lever arm at the opposite end, consequently the tendency for the equalizer to return to normal position would be increased.

The frame of the truck is of cast steel and as many of the features as possible are interchangeable with trucks of the older design which are not fitted with the clasp brake arrangement. These include the bolsters, spring planks and bridges. The



Spring Used on the New York Central Truck

weight of the truck complete is 22,500 lb. The length over all is 15 ft. 6 in. and the wheel base 11 ft.

All the springs are of the elliptic or semi-elliptic type and those over the journals are constructed with a removable shackle bearing on the end which acts as a seat for the spring hangers.

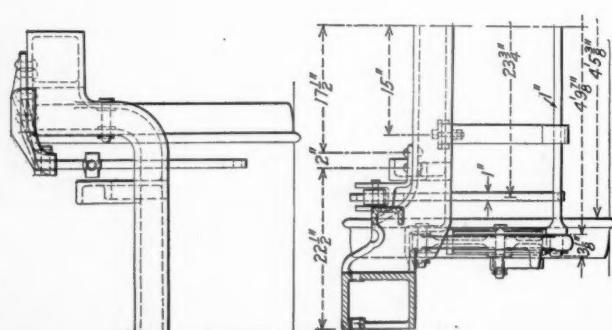
DEFECTIVE BOX CARS

The Buffalo, Rochester & Pittsburgh Employees' Magazine for May, 1914, contains a large number of expressions of opinion from conductors and agents as to how the thirty million dollars spent annually by railroads on claims for damaged freight may be reduced. Those expressions referring to poor condition of equipment are as follows:

"The poor class of box cars in the merchandise trade today is the cause of a great many claims. Among the worst is the car that, from an ordinary inspection, seems fit for loading, but through the roof of which the water literally pours during the first shower after a dry period. Cars with broken floors, sides, and ends through which the freight is lost, or the rain beats; cars with badly fitting doors into which the rain drives, especially if cars are in motion during a rain storm; cars with floors saturated with oil; especially are these defects hard to detect at night; cars with nails projecting, not because they have been driven in after the car has been put into service, but nails that have partly worked out by reason of the old and dilapidated condition of the car."

"Many of the car doors swing out from the bottom which enables anyone to pull out small packages of freight."

BALTIMORE & WASHINGTON CITY RAILROAD.—All who have occasion to pass between the cities of Washington and Baltimore, will rejoice with us to learn that the railroad is completed. Cars have passed both ways each day since the 20th inst. Long may they continue to do so unobstructed.—*From American Railroad Journal, July 25, 1835.*



EARLY TRAFFIC IN THE WELLAND CANAL.—By the annual report of the directors of the Welland Canal, it appears that there have passed through the canal the last season 570 schooners, 334 boats and scows and 66 rafts, the amount of tonnage of which was 37,927. The tolls in 1832 amounted to £2,432; in 1833, to £3,618; in 1834, to £4,300. The total amount of expenditure on the canal, including the year 1834, was £411,079, or nearly \$1,800,000.—*From the American Railroad Journal, February 14, 1835.*

DRAFT GEAR PROBLEM—SUGGESTED REMEDIES

Interesting Viewpoints Developed, Emphasizing Importance to Various Departments Involved

In selecting several papers from those submitted in the draft gear competition, for publication in this issue, it has been aimed to present as great a variety of views as possible. The widely varying viewpoints which are presented emphasize strongly the importance of the problem, and while they agree in general as to the best type of draft gear to use, each one of them approaches the problem in a very different way from the others.

FIRST PRIZE—THE DRAFT GEAR PROBLEM

BY E. W. NEWELL
Mechanical Engineer, Pittsburgh, Pa.

Draft gear—the real meaning of which is “an apparatus used for drawing a load”—when applied to railway equipment becomes not merely a pulling mechanism, but a shock absorber as well, and owing to the limited space allotted for its installation and the short movement through which it performs its work, the design, principle of operation and installation make it one of the most important, if not the greatest problem, confronting the engineer and designer of railway equipment.

The demands of modern railroading require the stopping of a heavy, high speed train in about one quarter of one minute, but the draft gear is expected to protect from injury the coupler, the car and its lading, in one-sixth of one second at the very low speed of one mile per hour and in proportionately less time at higher speeds.

It is not our purpose to go into elaborate statistics regarding the number of cars continually out of service on account of defective draft gears and attachments, or to give figures showing the high stresses to which the draft gear is subjected, but to describe the different methods which have been used to meet these conditions and to give results of laboratory and road tests, together with car repair records in order to show which principle, in the designing of draft gears, has proved to be the most efficient.

Various means, including the compression of liquids and air, have been employed to dissipate the shocks on railway vehicles, but the only devices which have been found practical are compression springs and a combination of springs and metallic frictional members, known as friction draft gear; the comments which follow will be confined to the merits of the spring and friction draft gears.

SPRING DRAFT GEAR

Since the discovery of metals, springs of different forms have been used as a cushioning medium and it was natural that they should have been selected for draft gear purposes in the early days of railroads. So long as railway equipment was of light construction, the trains short, and the speeds moderate, spring draft gears were satisfactory, but as these conditions changed, the light springs were found inadequate and those of higher capacity were substituted.

The increased capacities and weights of railway equipment, together with the general use of air brakes on freight trains, permitting higher speeds and longer trains, necessitated a still further increase in the capacity of the springs, and to such an extent that disastrous results occurred from recoil. If it were not for the reactive effect, the use of springs as a shock absorber would be an ideal arrangement on railway trains, because the power required to compress a spring is in direct proportion to its movement, and this is about the rate shock stresses should be dissipated to give the best results.

The damages resulting from the recoil of draft springs is most severe on cars in transit, not only to the lading, but to couplers and attachments and other parts of the car. The danger of

parting long trains equipped with spring draft gears and running at slow speeds is so great if the throttle is opened immediately after placing the handle of the brake valve in release position, before all brakes are fully released, that locomotive engineers rarely attempt it and some roads issue instructions forbidding it.

The capacity of draft springs is limited to their safe recoil effect, which is also the capacity of the springs to resist buffing stresses; it has been found to be only about one-third the capacity of a friction gear which does not have the damaging recoil results of the springs.

SERVICE RESULTS

The limited capacity of draft springs gives but a comparatively slight protection to heavy equipment in buffing; this fact was very forcibly brought to the writer's attention a few years ago, when inspecting a lot of cars at the request of a railroad official. Three years previously the road had purchased five hundred cars, alike in every respect except that one-half were equipped with spring draft gears and the other half with friction gears. After having been in the same service for the above length of time, all the cars were reported to be in excellent condition. The railroad was about to purchase additional cars and contemplated using spring draft gears, as the cars equipped with this device were apparently in just as good condition as those fitted with the more expensive friction device. The cars referred to were steel hoppers and their use was confined to ore service. The steel end sills were strengthened on the outside by a very heavy steel casting extending the full width of the car, the casting being so arranged as to take the final blow of the coupler horn. An inspection of many of the cars with both types of draft gears showed them to be in excellent condition, but a visit, the following day, to the repair tracks (the best place to obtain practical draft gear information) revealed a condition which proved conclusively the superiority of friction over the spring gears.

From the repairmen the writer learned that the 250 cars equipped with friction gears were still using the couplers which were applied when the cars were built. On the 250 cars equipped with spring gears all the original couplers had been broken, as well as a complete renewal of another make and at the time of the investigation all of the spring draft gear cars, which came in for coupler failures were being equipped with still another make, in the hope that the last type of coupler would be better than the other two. They failed to realize that the trouble was due to the end sills being so strong and the capacity of the spring draft gears so low that the coupler head was continually being driven against the end sill until it broke.

If railroads would keep accurate and systematic records of expenditures and replacements of repairs to freight cars, separating the cost of draft gear maintenance from general repairs, there would be many revelations similar to this.

From experience in car design and inspection of failures of different parts of railway equipment, together with the information obtained from reading railway literature and papers before our railway clubs, there is no question (and it seems to be corroborated by all published reports), that the enormous expense of car maintenance, damage to lading, delays from break-in-twos, etc., would be materially reduced if friction draft gears, properly applied and maintained, were standard on all railways. To be more emphatic, the universal use of friction gears, would show as great improvement in conditions as the change from link and pin connection to the present M. C. B. coupler.

LABORATORY TESTS OF DRAFT GEARS

Much time and space could be taken by presenting figures and charts of tests of draft springs on static testing machines and

under falling weights, from the early tests under the M. C. B. drop of 1,640 lb. to the present schedule of drop and rivet shearing tests under a 9,000 lb. weight, but these results have been published so generally and are so well-known that a rehearsal of this data is unnecessary. Drop test efficiencies of spring and friction gears may be briefly summed up by the following statements, which are results of demonstrations made at various times, under the auspices of railroad officers, and which are matters of common knowledge among railroad mechanical men:

(a) A 9,000 lb. weight falling 5½ in. closes the most powerful draft gear spring solid.

(b) A 9,000 lb. weight is required to drop from 15 to 20 in. to close solid a friction draft gear of ordinary capacity.

(c) The above draft gear springs placed upon a follower, supported by two standard draft lugs, attached to channels by nine 9/16 in. rivets in each draft lug, required 15 blows of a 9,000 lb. weight falling 6 in., and one blow from a height of 9 in., to shear the rivets.

(d) A friction draft gear, under the same conditions, before shearing the same number of rivets, required:

15 blows of a 9,000 lb. weight falling 6 in.
15 blows of a 9,000 lb. weight falling 9 in.
15 blows of a 9,000 lb. weight falling 12 in.
15 blows of a 9,000 lb. weight falling 15 in.
12 blows of a 9,000 lb. weight falling 18 in.

ROAD TESTS OF DRAFT GEARS

There are many who do not consider laboratory tests of much importance, because of the conditions being so different from service. For this reason there have been made, in different parts of the country, several draft gear demonstrations, with fifty car trains equipped with spring and different forms of friction gears. The two most important tests of this kind were the Santa Fe tests at Ft. Madison, Ia., in 1906, and those on the Los Angeles division of the Southern Pacific in 1908. In order to illustrate the comparative service operation of spring and friction draft gears, a few results of the demonstrations on the Southern Pacific (see report published in serial form in the Railway Age Gazette, and the Railway and Engineering Review, December, 1908) are given below.

JERK TEST

Set 10 rear brakes by air, take slack with full throttle and throw reverse lever ahead; engine worked on sand. (Train: 50 cars, dynamometer car the 41st.)

Spring Gear 260,000 lb. jerk	Friction Gear 120,000 lb. jerk
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BUFF TEST

Emergency application of the brake at a speed of 9½ miles an hour, steam shut off just previous to use of brake valve. (Dynamometer car 41st.)

Spring Gear 550,000 lb. buff (One broken coupler)	Friction Gear 155,000 lb. buff (No damage)
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RELEASE TEST

Accelerate train to 20 miles an hour, then apply brakes in service application and when speed has been reduced to 13 miles per hour open throttle of engine. (Dynamometer car 26th in train.)

Spring Gear 285,000 lb. jerk (Train parted)	Friction Gear 156,000 lb. jerk (No damage; train kept moving)
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BUMPING POST TESTS

In 1905-1906 a series of very interesting tests was made by a large railroad; the method employed showed in the best possible manner the inefficiency of spring draft gears. At the foot of a grade a substantial bumping post was erected, against which was anchored a dynamometer car. To the yoke of the coupler on the opposite end of the dynamometer car from the bumping post was attached a slide, containing the record paper, the buffering stresses from the striking cars being registered upon the paper, through the dynamometer, in the usual manner, the movement of the paper being co-incident with the travel of the coupler. The diagrams showed the actual operations of the gears in the same manner that an indicator card illustrates what takes place inside of a steam engine cylinder.

During these bumping post demonstrations, tests were made with loaded cars to about 3 m. p. h. and with an empty car to

7 m. p. h. and the records showed the low cushioning effect of spring gears more accurately and clearly than any laboratory or road tests could do.

FRICITION DRAFT GEAR

The preceding comments relating to the inefficiency of spring draft gears, disclose, in comparison, the superiority of the friction gear, which is admitted by all who have thoroughly and conscientiously investigated the draft gear question to be founded upon the best principle yet devised for dissipating the stresses to which railway equipment is subjected. The design of friction gears and the methods of operation have taken several forms, but unless some better principle than friction is discovered, friction draft gears, with possibly some modifications in design, will be used for many years to come.

Railroad mechanical men are often skeptically inclined towards the claims made by the makers of railway appliances, but it would seem that the friction draft gear manufacturers have done their part well in furnishing a device of such high efficiency, when it is considered that the spaces allowed for the apparatus are very limited and the travel (length of time for performing the work) is much less than it should be for dissipating shocks of such magnitude; and also to make it of sufficient strength, and at the same time as light as possible, so as not to increase the dead weight of the car.

The draft gear question today is one of close co-operation between the manufacturers of friction draft gear and the railroads, with especial care given to the proper installation upon cars, periodical inspections and renewal of repair parts when necessary. These suggestions, if put into practice, will undoubtedly result in more efficient service from draft gears and better protection to railway equipment and will assist greatly in answering that vital question which is worrying railroad officials so much today, as to "how to reduce the cost of car repairs?"

A REMEDY FOR DRAFT GEAR TROUBLES

BY GEORGE THOMSON

Master Car Builder, Lake Shore & Michigan Southern, Englewood, Ill.

What is draft gear and what is it used for? This may seem a very useless question, yet if the truth is to be acknowledged we must admit that the draft gear is one of the least understood and most abused appliances on railroad equipment. The draft gear is, to state it plainly, the cushion between the back end of the coupler and the car, and is put there to protect the car from hard knocks; therefore, the better the cushion we use the more protection we give the car, which means a reduction in freight car trouble and the cost of maintenance. At present draft gear is distinctly divided into two kinds—friction draft gear and spring draft gear—there being different designs of each kind.

Until, probably, twelve to fifteen years ago the draft gear commonly in use consisted of one or two springs having a capacity of 19,000 lb. each. These springs were attached to the coupler and car in different ways. With the old type of link and pin coupler this type of gear proved fairly satisfactory, but with the advent of the automatic coupler came the rougher and more severe handling of cars in switching service, so that it was found that a more powerful gear or cushion was needed; then springs having a capacity of 30,000 lb. were brought into use. The attachments for applying the draft gear to the cars were also improved and made stronger. While these springs gave more protection to the car, it was also found that they had a very destructive recoil, which caused a great amount of coupler trouble, such as broken knuckles, knuckle pins and coupler locks; in addition, this rougher handling of cars also entailed a vast amount of trouble in the draft gear attachments themselves, such as broken yokes, yoke rivets, center sills, draft sills, end sills, buffer blocks and broken draft timber bolts. On box cars came an increase in bulged or broken ends, leaking and damaged roofs and side doors damaged and missing—all this increase of

damage due to the more severe handling of equipment. A large amount of these troubles could have been prevented by the use of a draft gear giving more adequate protection.

Then came the steel underframe and all-steel car. On an all-wooden car the cars had some "give" to them when hit hard enough, and, while this may have helped out the draft gear, it was pretty hard on the car. With a properly designed steel underframe, or steel car, these conditions changed and the draft gear had to take the bumps, as there is no "give" to the steel car.

The capacity of the cars and the number of cars per train were also increased. Heavier and more powerful locomotives came into use, so that in addition to the damage to cars and lading in switching yards came an increase in difficulties in handling long trains, such as break-in-twos, which is a very serious matter. A break-in-two means that not only the train itself is delayed while the damaged car is being switched to a side track, but it may also delay other trains, and very often cause wrecks. Men studying this question came to the conclusion that a more powerful draft gear was needed; but, while they wanted more draft gear capacity, it was preferable to obtain this without any increase in recoil; in fact, it was found highly desirable to reduce the recoil of draft gears. Therefore, this additional capacity could not be obtained by the use of springs alone for the very reason that every pound of energy used to close a spring is returned in the form of a "kick-back" or recoil.

After a great deal of experimenting, the friction draft gear was devised. In this type of gear the springs are not called upon to do all the work, as the frictional resistance is brought into use. This causes a large part of the energy delivered to the coupler by cars striking together to be used in overcoming the frictional resistance of the draft gear friction parts. Thorough tests show that, while it would take a large amount of energy to close a friction draft gear, it also has very little recoil. Friction draft gears have been tested in different ways and have proved their superiority over any and all forms of spring draft gear, this not only in laboratory tests but also in road and service tests.

Several railroads have at times fitted out test trains, equipping them with different types of draft gear, both spring and friction, and conducting a series of tests. These experiments proved beyond a doubt that the trains equipped with a good friction draft gear could be handled with greater despatch and with far less liability of break-in-twos than trains equipped with any form of spring draft gear. The shocks to which these trains are subjected due to train handling were accurately recorded by means of a dynamometer car.

The tractive effort of the locomotive has increased from the 50,000 or 60,000 lb. of several years ago to as high as 160,000 lb. on a large Mallet engine just built. A locomotive having a tractive effort of only 60,000 lb. is sufficient to close a spring draft gear solid, which leaves no cushion in the gear to take care of emergencies. All these facts tend to prove the need for a draft gear giving more protection.

The original friction draft gears had a travel of $2\frac{1}{2}$ in., whereas the spring draft gears have only $1\frac{3}{4}$ in. This increase in travel alone was of great benefit, and, added to the other desirable qualities of a friction draft gear, helped to solve a large number of the draft gear troubles. Since then various designs of draft gear have been placed on the market, some of them being widely used today while others had only a short life.

Manufacturers are constantly endeavoring to improve their devices until now there is at least one make of draft gear having a travel of $3\frac{1}{4}$ in., an increase of $1\frac{1}{2}$ in. over the travel of the spring draft gear. This manufacturer realized that a long travel was not only desirable but very effective in destroying hard blows to which the cars are subjected.

The friction draft gear has solved many troubles and it remains to be decided which make is most desirable. The friction

draft gear should have some means to compensate for slack which may occur due to wear of the parts of the device. This provision to compensate for slack should preferably be some form of adjustment which will accomplish this without reducing the length of travel, as reduction in travel means reduction of efficiency. The design of draft gear should be such that it will exclude small parts which may be easily broken or damaged. The design should not be complicated, thus making it easy for the average repair man to handle it when necessary.

The draft gear is fully as important to a car as the air brake and it would be to the railroads' advantage if they would maintain as systematic an inspection of draft gear as they do of air brakes. If air brakes were applied to the car and never looked after, how long do you suppose they would give good efficient service? Other parts of the car are regularly inspected, so why not the draft gear and thereby keep it working at maximum efficiency? A preferable design of draft gear would be one that is easy to inspect and maintain. Some designs of friction draft gear are so constructed that if anything is damaged or broken the gear is a complete loss, while in others the broken or damaged parts can be replaced and the draft gear put in working condition.

Railroads which have made a fair and impartial investigation of various draft gears have never failed to find the friction draft gear far more efficient than any form of spring draft gear ever made. Statistics of the cost of car maintenance show that cars equipped with good friction draft gears cost far less to maintain than cars equipped with spring draft gears. Some roads, in keeping the cost of maintenance covering repairs due to draft gear performance, do not go far enough, as the cost of repairs to the draft gear does not cover everything. The cost of replacing broken couplers, broken sills, yokes, yoke rivets and attachments should also be included; in fact, it is hard to tell just where to stop, as a good friction draft gear protects the whole car while a poor draft gear causes more or less damage to the entire car, particularly in case of a box car, where it is not only destructive to the car but also to the lading. It also puts a car out of service while necessary repairs are being made, thus reducing the earning capacity of the car.

A number of roads which have had wooden cars equipped with spring draft gear that were a constant source of trouble, are at present stopping this trouble by removing the old obsolete draft gear and applying either steel underframes or cast metal draft arms to the cars and equipping them with good friction gear. The roads doing this have made a study of draft gear conditions and find that, while a spring gear is probably cheaper than the friction as to initial cost, it costs far more money in the end in paying for repairs because of poor protection.

While some of the roads have looked into the draft gear question, there are a number of them which have paid very little or no attention to it. They cannot realize what inadequate draft gear is costing them until they get right down and analyze the cost of repairs due to inferior draft gear and take into consideration the total cost necessary to put a car back into service after it has been hammered to pieces by not having the necessary protection. A number of roads have kept records of these costs and after doing it there has always been one result; they have quit using inadequate draft gear and have put on the best draft gear they could buy, with the result that, instead of having cars on the repair track all the time and having congested tracks, they are keeping their cars in service where they are earning revenue instead of helping to swell the expense account.

Another question. Why do not all railroads, when buying draft gear, make an investigation as to the merits of the different draft gears and have certain requirements covering draft gear? They will inspect various articles going into the manufacture of the car, but when it comes to the question of draft gear they generally do not pay very much attention to it. There are draft gear testing laboratories in this country where the railroads are

at liberty to conduct any laboratory test they care to. These laboratories have been put up at great expense by the draft gear manufacturers, and there are at least two companies which are willing to offer their laboratories to any railroad at any time in order that they may conduct draft gear investigations. It seems, however, that some of the railroads do not realize the importance of a draft gear and what it means to them in dollars and cents. When the selection of a draft gear is left to the purchasing agent, as it sometimes is, he will generally buy the cheapest sort of draft gear regardless of the fact that this same cheap draft gear is going to cost a whole lot of money for repairs later on. Again the selection of draft gear is often made by some superior officer who is not acquainted with the different devices, and who will often go against the recommendations of his mechanical men who have made a study of the subject.

The M. C. B. Association has made many and thorough investigations of various articles used in car building, but for some reason or other has done very little along the lines of draft gear investigation. I will grant that it has made some investigations and has gathered some valuable data, but it has merely scratched the surface and has not gone deep enough. Within the past two years it has conducted a long investigation into the manufacture and design of couplers with the idea of making a stronger coupler and thus reducing the enormous number of broken couplers occurring every day. At the M. C. B. convention held in Atlantic City in 1913, various types of couplers were on exhibition illustrating ideas of strengthening them and eliminating some of the present troubles. The weight of the coupler was increased from 300 lb. to 500 lb. to overcome coupler troubles. Again we ask the question, why do not they also investigate the draft gear and see if something cannot be done there and thus help the coupler troubles by using an efficient cushion back of the coupler?

Railroads which have followed it up know that fewer couplers are broken when used in connection with friction draft gear than when used with spring draft gear. These facts are also more forcibly brought out when the records include steel cars, for as above stated a steel car has no "give" to it, to help out the poor draft gear, as is the case with a wooden car. The steel car is here to stay, so why not use all the draft gear protection possible and reduce draft gear and coupler troubles to a minimum?

IMPORTANCE OF THE DRAFT GEAR PROBLEM

BY W. H. HAUSER

Engineer of Tests, Chicago & Eastern Illinois, Chicago

Before we can discuss draft gear intelligently we must have a proper understanding as to what is involved in the draft gear question. Just what relationship does the draft gear bear to the car? What is it designed to do for itself, or for the car? Is the whole matter of sufficient importance to merit discussion? Are there any differences resulting from the use of different draft gears? Is there enough involved to warrant any such investment of time and money as has been made to perfect the air brake, for instance?

The draft gear is very evidently placed where it is for the purpose of minimizing the shock delivered to the coupler in transmitting it to the car. It is evident that when running on a smooth roadbed, except in the case of wrecks, the car is not subjected to any damaging jolts or jars, except such as are delivered to it upon the coupler and through the draft gear. It is evident then that outside of certain normal repairs, which are necessary because of wear, on such parts as wheels, axles, brake shoes, journal bearings, or such items as painting, or air brake maintenance and lubrication, there is no car repair expense but what is directly chargeable to such shocks as are received by the coupler and transmitted through the draft gear to the car.

To thoroughly understand the draft gear and what is involved in it, it must first be appreciated that car repair ex-

pense, such as broken couplers, knuckles, knuckle pins, draft springs, draft sills, draft castings, followers, truck bolsters, oil boxes, etc., are directly chargeable to the shocks received by the coupler and transmitted through the draft gear to the car. Among breakages might be included bursted car ends, leaking roofs, loose running boards, missing car doors, bent underframes and broken end sills. Here is a damage, or a breakage, not due to legitimate wear, in which the draft gear is very evidently involved.

There is more involved in the draft gear problem than simply this breakage. Resultant upon car failures come delays to traffic and damaged lading; there is the further result of crowding of terminals, of the necessity for larger rip tracks and more repair shops. Without attempting to estimate what is involved in delays to traffic and the crowding of terminals, the expense of which, though enormous, is hard to estimate, it is possible to come to a better appreciation of what is involved in the draft gear by analyzing some of the statistics that have been published relative simply to car repair expense.

We get statistics as to what car maintenance is costing from statements issued by the American Railway Association, the Interstate Commerce Commission, and individual roads. The average cost to maintain a freight car in this country appears to be something over \$80 per car per year. Eliminating those parts of the car which wear, as being items that are not involved in the study of the draft gear, we find that a very large proportion of the car repair maintenance cost is caused by breakages. Breakages do not come from wear, but from blows or shocks. The draft gear was originally put on the car, and the supposition is that it is now placed on the car, for the purpose of preventing any disastrous results from blows or shocks which may be delivered to the coupler. Without any argument to prove just exactly how much expense is chargeable to shocks, it can safely be assumed that the car "breaks" down much faster than it "wears" out.

Recent statistics, covering eleven of the larger western roads, show that on the average each freight car of the eleven roads was repaired once a month, at an average cost per time of repair of \$6.26. This gives for the twelve months, or one year, over \$75 in repair expense. The cost of repairs on the eleven roads referred to ran from a minimum average of \$35 per car on one road to a maximum average of \$134 per car on another during the years 1909, 1910 and 1911. The average mileage per car per year ran from a little over 5,000 miles as a minimum to nearly 20,000 miles as a maximum.

These figures are interesting in showing the average mileage of cars and the average cost of maintenance for the mileage made, but in making this mileage, if these same cars were subjected simply to normal or natural wear, such as would occur on wheels, axles, journal bearings, brake shoes, or items of this kind, the average car repair expense could not possibly come within one-half of the \$75 which it cost to keep these cars in repair. Similar figures may be obtained by anyone interested, and are easily verified.

There is involved, then, in the draft gear problem, car maintenance expense to rather large and startling figures. While these figures refer only to a few roads, for only three years, other figures are easily obtainable, covering a period of eleven years. For instance, on some of the larger roads the expense of maintenance per car mile ten years ago was as low as 3.7 mills; in 1911 this expense increased to 7.9 mills, an increase of over 113 per cent. There should be taken into consideration, of course, in the increase in maintenance expense, the increase of capacity and the revenue load increase. Referring to this same group of roads, statistics show that during a period of eleven years there was an increase in freight car capacity of 34.19 per cent, and a revenue load increase of 28.54 per cent, but with it an expense of mainte-

nance increase of 67.85 per cent. The car maintenance expense in which the draft gear is not involved is certainly large enough in any one year, but the increase of the maintenance expense in which the draft gear is involved is simply appalling. It would be bad enough if we could stand still, but where is a continued increase to lead us?

Figures from 1900 to 1910 throw an interesting side light on the maintenance of equipment as compared with maintenance of way and the cost of conducting transportation. In 1900 the proportionate cost to the whole of conducting transportation was 55.04 per cent; for maintenance of way, 21.97 per cent, and for maintenance of equipment, 18.84 per cent. In 1910 the proportion was, for conducting transportation, 50.29 per cent; for maintenance of way, 20.22 per cent, and for maintenance of equipment, 22.66 per cent—a decrease in the first two items, but a decided and large increase in the last item, that of maintenance of equipment.

To cite an individual case, the cost of maintenance of way and structures on one of the large railways for the calendar year 1910 was \$20,342,488. The total cost of conducting transportation was \$57,200,886. The ratio of maintenance of way to cost of transportation was 35.56 per cent. It constituted 17.71 per cent of the total operating expense, and took 12.67 of the total operating income. Maintenance of equipment cost \$31,117,989 and its ratio to expense of conducting transportation was 54.27. It constituted 27.1 per cent of the total operating expense, and it took 19.38 per cent of the entire operating revenue of the road. Repairs and renewals of locomotives cost \$3,612 per locomotive. There were 3,426 locomotives—hence the entire expense of maintaining them was \$12,375,605. This was \$2,277,038 more than the cost of all the fuel they burned. It averaged 12.79 cents per mile run. Maintenance of freight cars cost \$13,840,087, or \$99.08 per car. The total cost was \$3,741,526 more than the total cost of fuel burned in locomotives. The total freight car mileage was 1,172,687,533. The cost per freight car mile was therefore 1.18 cents.

To run a freight train of fifty cars a hundred miles cost as follows:

Locomotive maintenance	\$12.97
Fuel	10.44
Freight car maintenance.....	55.00

In other words, it cost to maintain the freight cars in the train more than two and one-third times the cost of fuel and locomotive maintenance combined.

Take twenty-two of the larger roads and the expense of repairing freight cars in the two years 1910 and 1911. These figures are easily available and their accuracy is not in question. In 1910 the average capacity of the freight cars on these roads was 35 tons, in 1911 the average capacity was 35.9 tons, an increase of 2.6 per cent, but the average number of tons of revenue freight per loaded car was in 1910, 20.2 tons, and in 1911, 20.14 tons, a decrease of 0.3 per cent. The total cost of maintenance expense of the freight cars on these twenty-two roads for 1910 was \$64,516,474. In 1911 the same expense was \$78,841,349. The cost of maintenance of freight cars per mile run in 1910 was 0.71 cents, and for 1911, 0.90 cents, an increase of 26.75 per cent.

Again it becomes most apparent that there is a great deal involved in the draft gear problem. It is not the wear to freight cars that is costing money—it is the damage to freight cars that is piling high the expense. The damage comes, not from the wear upon the coupler, but from the blow upon the coupler, and from the fact that the blow upon the coupler is transmitted through the draft gear to the car. It is very evident that the blow should not be transmitted, but should be absorbed in the draft gear, even at the expense of the draft gear, as it is a self-evident proposition that it would be very much cheaper to repair draft gears than it is to repair cars.

A more recent analysis of the freight car maintenance record over a period of ten years for thirty of the leading railroads, giving in detail the number of car miles and the total expense, shows the cost per mile run in 1902 to have been 0.569 cents; in 1912 to have been 0.918 cents, an increase of 61.3 per cent. During that period the average capacity of freight cars in service increased 33.46 per cent and the average number of tons of revenue freight per loaded car mile increased 21.63 per cent. On the basis of the ton mile there is an increase of 39.15 per cent in the cost of freight car maintenance. These same figures show that the highest cost per ton mile is 1.223 mills, and the highest cost per car mile is 1.390 cents. Cost for maintenance of equipment, 100 tons, 100 miles, on a group of four roads was in 1902, \$4.44; in 1912, \$5.72. On another group of four roads in 1902 the cost was \$4.70, as against \$7.19 in 1912, an increase of 52.98 per cent. On a group of ten roads where the cost was \$7.53 in 1902, it was \$10.15 in 1912 an increase of 34.79 per cent. A bulletin of the American Railway Association of a few months ago showed an average of 6.93 per cent of the freight cars in the repair shop.

There seems to be no question from the mass of authentic statistics available that car maintenance expense is upon the increase and is increasing more rapidly than are the expenses in any other department of railroad operation. As a large proportion of the car repair maintenance expense is not due to simple wear of parts, but to damage of parts, and as damage comes from blows or shocks, and as blows or shocks should be minimized in the draft gear, there seems to be but one conclusion, and that is that the draft gear and what is involved in it is a matter of tremendous importance. The millions of dollars of car repair expense can be very greatly reduced by the reduction of damage resultant from shocks in railway operation. The reducing, minimizing or eliminating of shocks is something which should be taken care of in the draft gear. It becomes then a very important matter in the purchasing of draft gear to select a type which, under test, shows the highest capacity with the least recoil.

THE SO-CALLED DRAFT GEAR PROBLEM

BY MYRON E. WELLS
Ann Arbor, Mich.

From an economic standpoint the draft gear problem is certainly most important. W. E. Symons, before the Western Railway Club, made a very reasonable estimate of the annual cost of repairs to freight cars that occur through the draft gear alone, and placed the figure at approximately ninety million dollars. This does not take into account the loss and damage claims, the cost of switching bad order cars to and from the repair track, the delays to traffic and the consequent overtime. It is also a most important factor in keeping the average daily mileage of freight cars down to the very low figure of twenty-five miles a day. This, to my mind, is a great source of lost efficiency, and one not usually taken into account.

The combined effect of all these handicaps results in greatly reducing the efficiency of the railroads. When all these matters are carefully considered and taken into account, the recent estimate quoted by the Railway Age Gazette of two hundred and fifty million dollars' damage per annum caused by draft gear troubles is not far wrong. At any rate any efforts to solve the problem are certainly worth while, and I am very glad to add my mite, because I have for a good many years held some very positive ideas on the subject.

It is already well known that the modern type of friction draft gear is the best and most efficient so far produced. Understand, I am speaking of the type in general, and not any particular make. And with this improvement in friction draft gears we have advanced some, but the problem of reducing the expense of car repairs is still unsolved.

I want to ask, in this connection, why is there this distrust

as to the work of our mechanical men along the lines of improved draft gears? No one is offering prizes for data to show that the locomotives and cars of the present day are an improvement over what we had ten and twenty years ago, because that fact is beyond question; so, also, is the fact of the present improved friction draft gears. Our railroad mechanical men are a valiant lot. They are usually equal to any emergency. They have made wonderful strides in improving locomotives and cars generally, but their work on improved draft gears is questioned and in grave doubt, so much so that it is now asked, What have they done? Is there any real improvement, and what is now the most efficient type of draft gear?

On the improvement of any particular mechanical problem the effort put forth, and the improvement made, is usually in proportion to the necessity for improvement; and of all the important necessities in modern railroading none has called louder or been more persistent than the one that has asked for an improved draft gear. My private opinion is that this has been well met by our mechanical men, and, considering the limitations under which they have been compelled to work, they have done nobly in producing the present friction draft gears, and their efforts are to be commended rather than questioned and criticized. If there is anyone who doubts the efficiency of the present friction draft gears I would ask him to not only read, but study carefully, first, the tests of a committee of the Master Car Builders' Association reported in 1908. Second, the actual road tests on the Southern Pacific Railroad, published in the Railway Age Gazette of January 8, 1909. Third, the facts and figures presented by J. C. Fritts on this subject at the September, 1913, meeting of the Central Railway Club.

If they will take the trouble to go over this evidence carefully I do not understand how they can still continue to doubt. As for myself I am thoroughly convinced, not only from the facts cited, but from personal experience, that modern friction draft gears *do* absorb shock; and the Master Car Builders' tests show that draft gears after from one to five years' actual service were equally efficient with the new in absorbing the shock.

Perhaps a large share of the distrust in friction draft gears comes from the fact that the method of absorbing the shock by friction is sort of paradoxical and hard to understand. It is also most clearly shown that these modern friction draft gears do away with practically all of the shocks from recoil, and if they did only this one thing they would still be enough better than the old spring gears to warrant their substitution. That, in a general way, they are stronger and more efficient is shown most clearly and emphatically by Mr. Fritts' figures. It must be remembered that our mechanical men, in dealing with the draft gear problem, have had to stay within the limitation of $2\frac{1}{2}$ in. or 3 in. travel, and have had to build the drawbars inside of the limitation of one square foot. With these limitations they have done as well as could reasonably be expected. If you could give them a 5 in. or 6 in. movement instead of $2\frac{1}{2}$ in. or 3 in., they could make the friction plates take up much more shock. Also if they had five or six square feet instead of one square foot, they could build a stronger drawbar. But this first is out of the question because you could not then keep the air hose coupled, and in the second case you would complain of the increased expense.

Is there then a solution of this problem? Surely there is. But it is not to be found, in my opinion, along the lines of your suggested competition, nor in finding the most efficient type of draft gears. The solution of the problem is not mechanical. The remedy lies with the operating official in stopping the outrageous and unwarranted destruction of cars in our switching yards.

BETTER OPERATION NEEDED—NOT BETTER DRAFT GEARS

Mr. Fritts, of the Lackawanna, in classifying the damage done to draft rigging, places it in the following order: First, damage on the road because of the introduction of heavier power and larger trains; second, the switching of light and heavy cars to-

gether; third, and he says the most important, is the starting of trains and taking slack. Under this head he mentions as a suggestion that cars are sometimes damaged in switching yards. I do not like this classification, and I am going to put the switching of cars in yards as the one great cause of most of our drawbar trouble. Cars are damaged in yards 20 to 1 for those damaged on the road, and my proof for this is the difference in the trouble in maintaining the draft gears on yard and road locomotives.

In road work practically all of the work is done on the tender drawbar. Any roundhouse foreman can tell how long an average tender draft gear will last in the average switching yard. The fact of the matter is that they do not last at all; and for this reason you will find all yard locomotives doing the work with the front end. Not only this, but you will find that the front ends of yard locomotives have been wonderfully strengthened beyond anything possible on an average tender or car. The extension frames have been shortened and made much heavier; in some cases a large cast steel filling piece is placed between the frames to add strength. Then it has been found that the ordinary front-end timber is entirely inadequate, and this has been replaced by a cast steel member, and even then the roundhouse foreman's troubles are not over in maintaining it.

The necessity for switching from the front end of yard locomotives is so great that in some cases the reverse lever has been changed to the left side of the locomotive in order that the engineer may be on the inside of the curve in some yards where a large amount of switching is done. And while there is all this trouble with yard switching engines the roadmen are going along day after day doing all the work with the drawbar on the tender, with very little drawbar trouble.

During a six months' period recently I rode thousands of miles on freight trains on a trunk line railroad; and in that time no train I was on pulled out a drawbar, and I received but one severe shock, and this did not damage the drawbars to make a delay. In a large majority of cases where drawbars are pulled out on the road the initial damage was done in some switching yard. In this connection I want to speak of the work done by the Air Brake Association and the Traveling Engineers' Association in reducing the shocks in road work. They are entitled to a great deal of credit for the work that has been done; and yet practically nothing has been done to decrease the shocks in switching yards. In fact I sometimes think that the stronger and more efficient the draft gears become, the harder the switchman persists in throwing the cars together.

Mr. Fritts in his report says that from 70 to 80 per cent of the drawbar damage was due to shock, and he further adds: "If this monster shock is responsible for so great an expense to the railroads in general, and we all know that it is, what should be done to relieve the equipment of the ravages of this demon?" Do we all know that this "monster shock" is responsible? For myself I have known it for years, and I believe with Mr. Fritts that every railroad man in this country knows it also, and if this is true, and we have the courage of our convictions, why can not the problem be solved?

Operating officials have side-stepped it long enough by making themselves believe it was a mechanical problem. So far as I am concerned, the whole object of this paper is to answer Mr. Fritts' one question, and the answer is very simple. The solution of this so-called draft gear problem does not depend upon any particular type of draft gear. It is a matter of stopping the present methods of switching in our yards. A solution of a very large percentage of the trouble will be accomplished when operating officials cut the speed of switching operations in yards. I know on practically all the railroads in this country that the switchmen are supreme in the matter, but the officials must take a stand and stop the destruction.

To back this argument I want to cite that the Pennsylvania Railroad some five or six years ago issued an order limiting the speed of switch engines to two miles an hour, and it is well

known that the Pennsylvania road is leading in this matter, and that it has some very rigid rules, and that it is actually stopping in a great measure rough switching in yards. In most yards five miles an hour is considered slow switching, and four cars cut off at one time is a reasonable average. These four cars, loaded, weighing approximately 600,000 lb., striking other cars at five miles an hour, develop over a million foot pounds of energy, and this shock is more than any draft gear can possibly be made to stand, friction or otherwise.

Locomotive boilers are built on a factor of safety of four. What would you think of the sanity of a man who would allow 800 lb. of steam put on a boiler that was made to carry 200 lb.? This seems a very silly question, yet you are allowing your draft gears on cars to be mistreated as badly as this every hour of the day and night. If there is a general manager who doubts my statement he can convince himself by spending a few days and nights in some switching tower watching the actual work. To get his full money's worth he must make sure his presence in the tower is not known to the switchmen.

I believe you will all agree with me that any time now gained in *hurry-up* switching is more than lost in the extra switching of the bad order cars produced by the *hurry-up* methods. But whether this is true or not makes little difference because cars cannot be made to withstand the shocks they get, and I know of no solution but to cut out the shock.

All of this expense and destruction to the freight cars does not take into account the millions of damage claims paid annually on account of rough switching. The Santa Fe has a special committee working to reduce the damage claims, and it is spending much time on methods of loading and schemes of fastening freight in cars so that it cannot move, etc. This is all very good in a way, but if it really wants to accomplish much in a short time I would suggest that it join forces with the mechanical officials, and go in a body to the operating officers and persuade them to issue some kind of an order that will stop the rough switching in yards. It will save them millions annually in both freight car repairs and in freight claims, even after they have put on a few more switch engines and crews.

Most railroads handle their passenger equipment in a reasonable manner, and I have maintained for a good many years that no general manager would go wrong if he ordered all freight cars switched in the same way that passenger cars are usually handled. If we are really convinced that this problem is no longer mechanical, and that the large amount of money spent annually for car repairs and freight claims can be reduced by stopping the outrageous switching methods in our yards, then will the so-called draft gear problem be solved.

RAILWAY COMMUNICATION WITH THE ISLE OF WIGHT.—The Isle of Wight Chamber of Commerce has passed a resolution expressing the view that a train ferry either from Stokes Bay to Ryde or across the Solent would be a more practicable scheme than the projected Solent tunnel between the Isle of Wight and the mainland.

THE TANGANYIKA RAILWAY OF GERMAN EAST AFRICA.—The Tanganyika Railway is a meter gaged line owned by the East Africa Railway Company which was recently completed from Dar-es-Salaam on the Indian ocean across German East Africa to Kigoma on Lake Tanganyika. The most important locomotives used on the line are of the consolidation type. They burn wood almost entirely and have an inside heating surface of 1,372 sq. ft., and a grate surface of 28 sq. ft. The locomotives have 40 in. diameter driving wheels, 17 x 21 in. cylinders and a weight in working order of slightly over 101,000 lb. They are capable of hauling a load of 500 tons on level track, but on one division where constant grades of 1.6 to 1.8 per cent. are met with for a distance of about 25 miles, the weight of the train has to be reduced to 260 tons. The sharpest curve met with on the line has a radius of 850 ft.

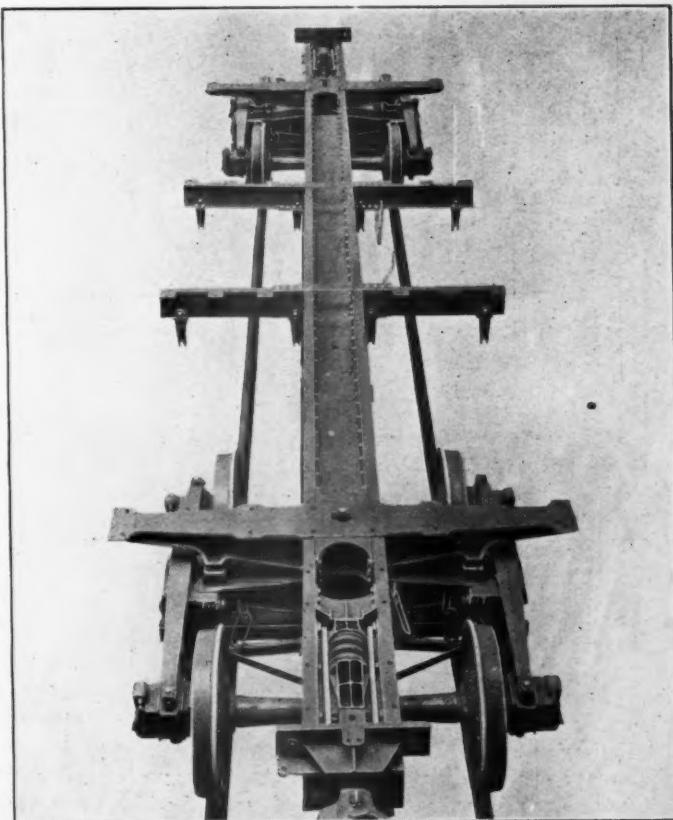
DAIRY REFRIGERATOR CAR

The latest design of refrigerator car built by the Milwaukee Refrigerator Transit & Car Company contains many interesting features that are original with the builders. The car illustrated herewith has a rated capacity of 60,000 lb., and weighs ap-



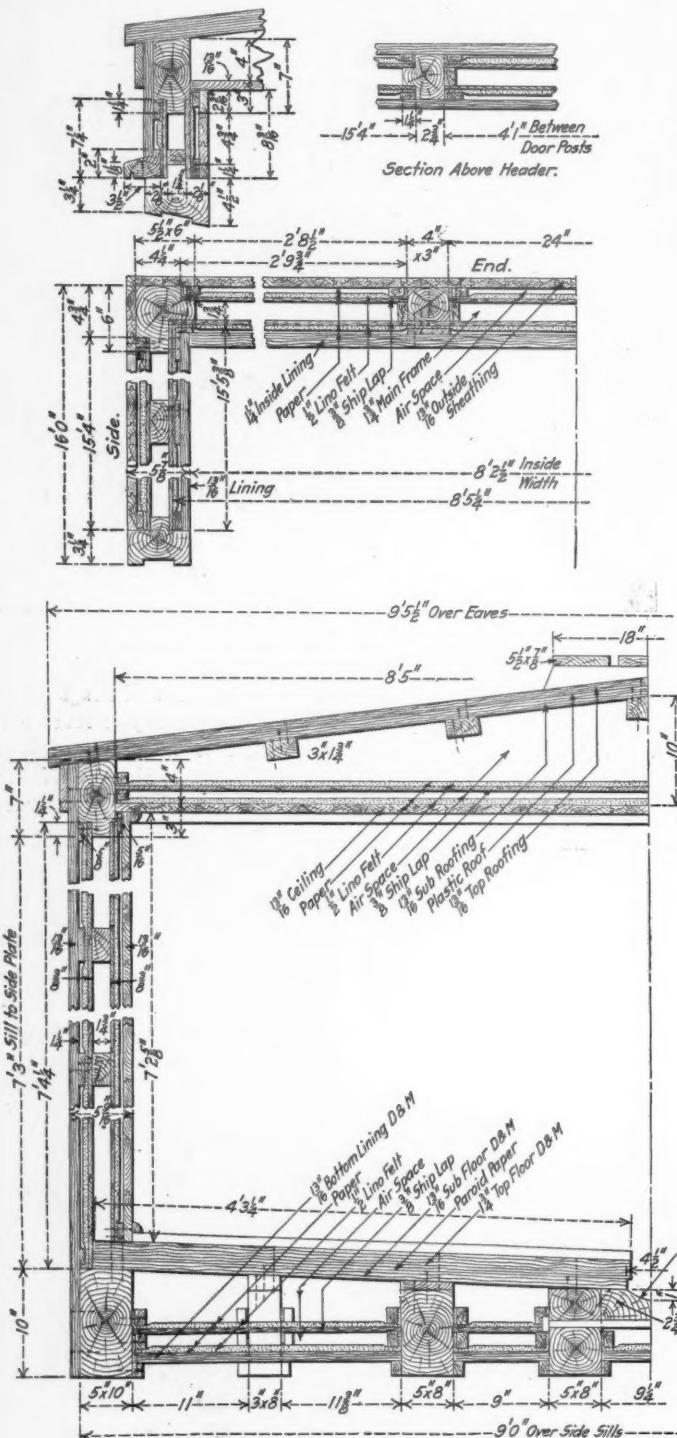
Applying Hot Asphaltum to the Car Floor

proximately 41,500 lb. This design is used for either beer or dairy traffic with but few modifications. The superstructure is entirely of wood, while the underframe is made up of both wood and steel members. The steel portion of the underframe is made up of two 9 in., 20 lb. channels for center sills spaced



Steel Underframe for the Refrigerator Car

13 in. apart. A 13 in., 32 lb. channel is riveted to these channels forming the bottom chord to the center sill girder. A needle beam is located 3 ft. 5 in. on each side of the middle of the car, and there are four truss rods extending the full length of the car, and anchored in the end sills. The needle beams are 9 in., 13.25 lb. channels, and are fastened to the center sill channels by angles. In addition to these a $\frac{1}{2}$ in. plate, 3 ft.

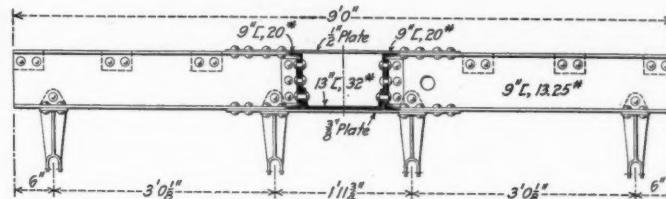


Insulation Details of the Milwaukee Refrigerator Transit & Car Company Dairy Cars

3 in. long and 3 in. wide, is riveted to the top flange of the channels extending across the top of the center sills, and a $\frac{3}{8}$ in. plate of the same dimensions is riveted to the lower flanges of these channels, extending across the bottom of the center sills. The wooden sills of the underframe, of which there are eight, including the side sills, are bolted to the needle beams by $\frac{3}{4}$ in. bolts.

The superstructure is entirely of wood. The roof is composed of two layers of 13/16 in. roofing boards with a layer of plastic roofing between. The siding consists of 13/16 in. outside sheathing, with 13/16 in. inside sheathing on the sides, and $\frac{3}{8}$ in. on the ends.

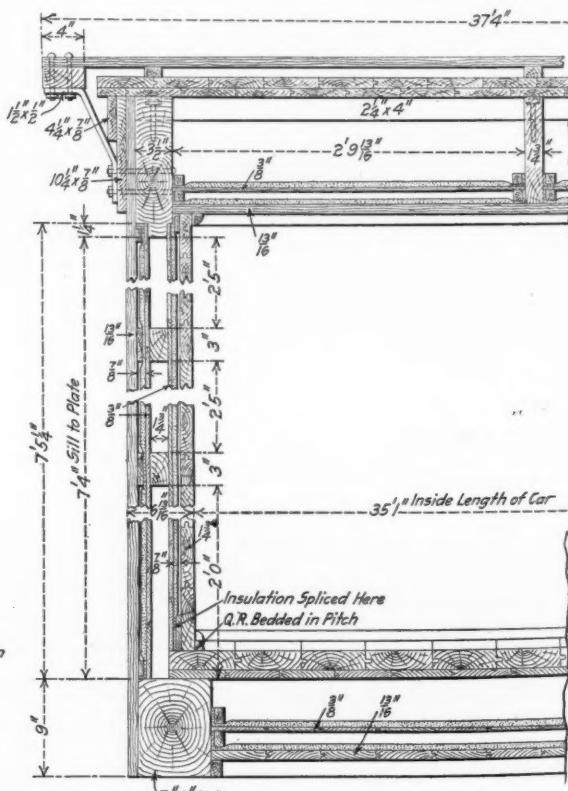
One of the interesting features of the flooring is the trough in the center for draining the moisture from the floor. This trough is formed in a board set flush with the wooden center sills, and is covered with galvanized iron which is lapped over



Cross Section Showing Connection Between Needle Beam and Intermediate Draft Sill

the sub-floor, as shown. Outlets are provided at both ends of the car just in front of the ice boxes, the drain pipes extending down through the insulation and center sill. The floor is made on an angle so that the water will readily drain into the trough, and oak floor strips are placed transversely the full length of the car.

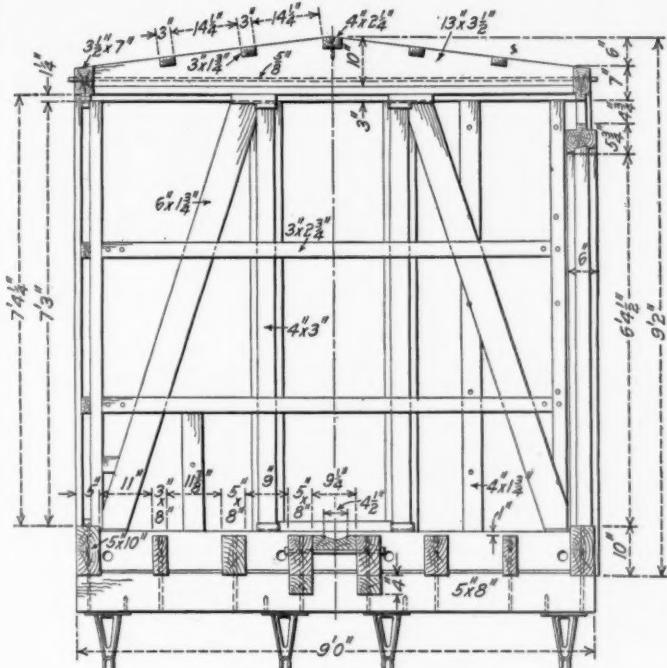
The insulation is clearly shown in one of the illustrations. It will be noted that the insulation in the corners is well lapped.



around nailing strips to insure a heat tight joint. The felt insulation on the inside of the car extends clear around the car in one piece, and the two layers in the ceiling extend across the car between the carlines. The sub-floor is covered with a hot asphaltum compound, and all the corners around the framing are filled as shown in one of the photographs. This not only seals the joints from the transmission of heat, but also provides

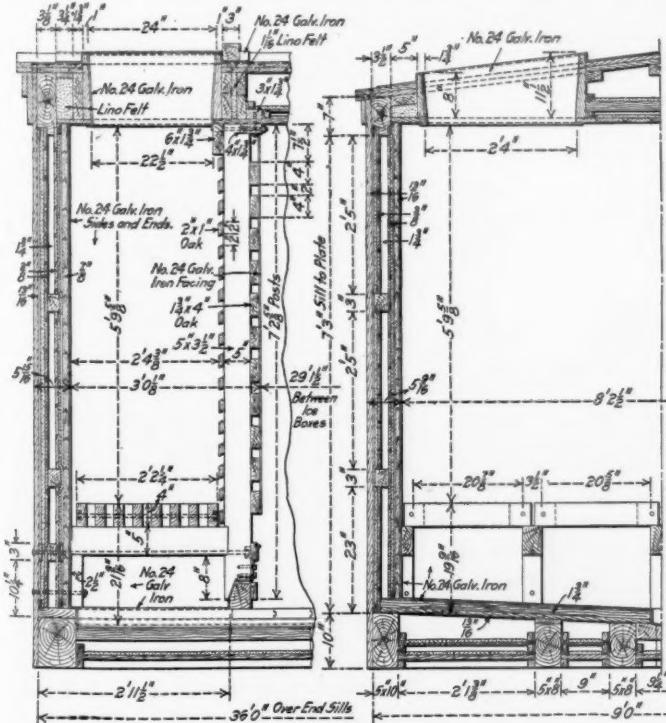
a waterproofing which is very necessary with this type of car.

Special attention has been given the construction of the ice boxes in the dairy cars. The ice hatch is substantially built with heavy blocking on all four sides to prevent its being knocked out of shape, and thus injuring the insulation. The



Details of the End Framing

bulkhead is made up of five 5 in. by 3 1/2 in. oak posts, to which are applied horizontal 4 in. by 1 3/4 in. boards spaced 2 in. apart on the outside, and 1 in. diagonally cut strips on the inside. The ice bars are 4 in. by 1 3/4 in. oak, and are made in four sec-



Arrangement of the Ice Box

tions across the car. They are supported by blocks extending from the bulkhead to the sheathing, as shown in the illustrations. The inside of the ice box is covered with No. 24 gage galvanized iron, as are also the strips on the outside of the

bulkhead. These strips are so covered to prevent undue abrasion, and to make it impossible for thieves to cut through the bulkhead into the car.

The principal dimensions of the car are as follows:

Length over end sills.....	36 ft.
Width over side sills.....	9 ft.
Length inside.....	35 ft. 1 in.
Width inside.....	8 ft. 2 1/2 in.
Distance between bulkheads.....	29 ft. 1 1/2 in.
Length of ice box.....	2 ft. 4 1/2 in.
Height of ice box.....	5 ft. 9 1/2 in.
Width of ice box.....	8 ft. 2 1/2 in.
Capacity.....	.60,000 lb.
Weight.....	.41,500 lb.

PACKING AND LUBRICATING JOURNALS*

BY G. J. CHARLTON

General Foreman, Car Department, Delaware, Lackawanna & Western, Buffalo, N. Y.

The waste employed in lubricating car journals should be of a good quality of wool, entirely free from grit or dirt, and also from any objectionable material that is at times found in the waste as furnished from the market, such as needles and other foreign substances which may not be readily observed, but which contribute to bringing about a hot box. In the preparation of packing, care should be taken to see that the quality of oil prescribed for summer or winter season is used accordingly, as failure to observe this at the change of season will cause trouble. This is all a matter of common sense, the lighter oil being used in cold weather, when its density is increased and it produces the same condition as the heavier grade in the warm weather. The weather conditions in both instances act as an agency of proper distribution and assist in maintaining the proper percentage of oil in the waste over the entire journal box.

The waste and oil should be mixed in the proportion of 80 lb. of waste to 90 gal. of oil, to insure a thorough saturation of the waste. This mixture should stand for 48 hours in a room in which the temperature is kept at from 68 to 70 deg., after which 50 gal. should be drawn off, leaving the ingredients in the proportion of 1 gal. of oil to 2 lb. of waste or 4 pt. of oil to 1 lb. of waste. These proportions may appear to make the packing somewhat dry, but my experience is that they bring the best results. A greater amount of oil than this is useless, as this mixture gives ample lubrication.

In the entire repacking of journals when cars are passing through the shops or over repair tracks, the treatment should be different from that given to loaded cars lined up for train movement. First, remove all the packing from the journal box and clean out the box thoroughly, leaving no particles of grit or dirt. All of the packing removed should be taken to the reclaiming plant and worked over, as will be explained later. Next take a handful of new packing and twist it to the form of a rope so that it will fit in the back of the journal box and form a dust guard as well as a filler; then fill the box to the center line of the length of the journal, the centering hole in the end of the journal serving as a guide to the proper height, keeping the packing inside of the journal collar and seeing to it that the box is not too tightly packed. Place one piece of packing in front of the journal as a wedge to keep the packing on the sides in place; this should have no connection with the packing on the sides or under the journal. See that no loose ends of packing hang out, as they will draw the oil from the box.

Filling the box to the center of the journal is important, as packing lying above that point is apt to be caught and drawn between the journal and the bearing, producing friction which results in numerous hot boxes on account of its action in hardening the material in the journal bearing.

A box thus packed should be in condition for six months*

*From a paper presented before the Niagara Frontier Car Men's Association, Buffalo, N. Y., May 18, 1914.

service. In being placed in train service it should receive the following treatment about every 400 miles: Adjust the packing, removing any from the side of the journal that may have become dry and unserviceable, and bring the well saturated packing from the bottom of the box up to the journal. Be careful that the packing on both sides of the journal is not beyond the proper limit of height, and is all on the inside of the journal collar. The part removed from the sides of the journal, or some of it, may now be replaced in front of the journal as a wedge and should have no connection with the packing under the journal.

This system if closely followed will produce satisfactory results and reduce hot boxes to a minimum, but of course circumstances over which we have no control or at least very little control will always be the cause of more or less trouble. From reports of the hot boxes on the Buffalo division of the Lackawanna for 30 consecutive days the hot boxes on foreign equipment are shown to have been 82.7 per cent and on home equipment 17.3 per cent.

Over a longer period and comparing the number of hot boxes with the mileage made on freight trains, we have for the year ending October 31, 1913, a total mileage of 272,388,146 and a total of 5,274 hot boxes, or a mileage of 51,837 to one hot box. For the same period there was a passenger mileage of 43,165,465, and a total of 79 hot boxes, or a mileage of 546,398 to one hot box.

The reclaiming of the packing previously referred to is done by pressing out the oil, picking over the packing, removing the dirt and grit as much as possible and then placing it in a reclaim tank where it is steamed for 12 hours to remove any further dirt and grit and restore the elasticity. It is then pressed and 200 lb. of old packing are mixed with 40 lb. of new waste saturated with 70 gal. of oil and allowed to stand 24 hours, after which 50 gal. of oil are drawn off, leaving the reclaim consisting of 10 gal. of oil to 120 lb. of waste. This makes a packing as good as new.

Certain other points come in immediate relation to the proper method of packing and, if given close attention, will help to keep the packing in good condition and assist in the prevention of hot boxes. One of these is the dust guard, which should be watched carefully and maintained in normal condition. The journal box lid should be in place and the fitting and tension maintained. This will prevent as far as possible dirt from entering either the front or back of the box.

There are causes of hot boxes which cannot be traced to lack of lubrication, such as hard roadbed and low and high joints. The latter cause trouble in boxes that have not been treated for some time and the packing having become soggy will not return to its former position in the box after being pushed down by the action of the journal.

Care should be taken in renewing journal bearings to see that they have a proper crown bearing. The journal wedge should not be too tight on the bearing, as it will pinch the bearing to the journal, causing the edges of the bearing to prevent the entire lubrication, and if it is too loose it will permit too much crown bearing, causing a tendency to break the journal bearing by a concentration of weight on the crown. A factor that should be kept in mind is the great care to be taken in the changing of wheels on repair or shop tracks, more especially on cars used for high class freight, as these cars are intended for fast movement and hot boxes on them involving delays invite more than ordinary criticism. The writer believes that the number of cars heating immediately after such work could be reduced to a minimum if special care were given at the time of doing the work to see that the boxes were properly packed. At the present time when piece work is predominant and the money earned the chief object in the view of the men, this feature cannot be brought too strongly to the attention of the foremen.

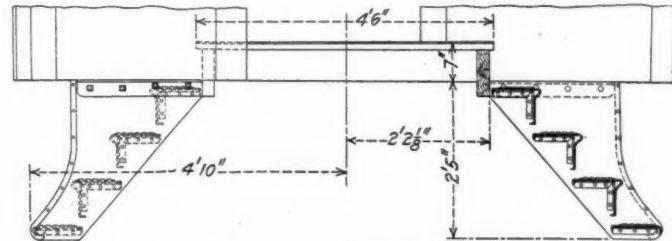
In the handling of wheels for shipment to and from the

wheel press, and in fact from the supply track to the car under which they are to be used, and in the removal from the car, the men engaged should be instructed to see that the journals do not become marred or dented. This is quite apt to occur and the condition likely to pass unobserved, and wheels applied in such condition are a source of hot boxes.

The filled journal bearing should not escape attention. Earnest efforts have been made by the Master Car Builders to eliminate them and not the least reason for doing so is the fact that it is impossible for a car inspector to obtain even a reasonable knowledge from the exposed end of the bearing of the extent to which they are worn. Of the hot boxes developing on freight trains on the line of the Delaware, Lackawanna & Western between Buffalo and Binghamton during April, 1914, 55 were caused by filled journal bearings on foreign equipment. This will be appreciated when we consider the few lines using these journal bearings, showing that a large percentage of them develop hot boxes.

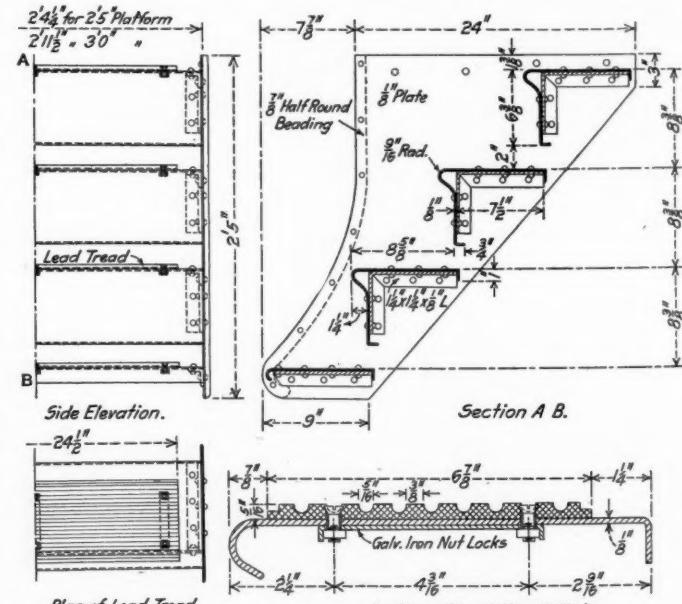
STEEL STEPS FOR PASSENGER CARS

The Canadian Pacific is using all-steel steps both on steel and wooden passenger equipment. The accompanying illus-



Application of Canadian Pacific Steel Steps to a Passenger Car

trations show the design of these steps in detail as well as the application to the car. The step and the riser are made in one piece and are connected to the end pieces by means of $\frac{1}{4}$ in. by $\frac{1}{4}$ in. by $\frac{1}{8}$ in. angles. These angles are spot



Details of the Canadian Pacific Steel Steps

welded to both the step and riser and the end pieces. The practice originally was to make these connections by means of rivets, but it is now done entirely by means of spot welding. The end pieces are $\frac{1}{8}$ in. plate reinforced at the outer edges by $\frac{1}{8}$ in. half round beading. Lead tread plates are used and held in place by bolts as shown.

SHOP PRACTICE

HOT WATER BOILER WASHING SYSTEM

BY E. A. MURRAY

Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

A hot water boiler washing and filling system was installed at the Clifton Forge shops of the Chesapeake & Ohio about two years ago. It serves 25 stalls in two roundhouses and its operation has been very satisfactory. It has decreased the amount of coal used in firing up by about 1,200 lb. per locomotive; at a large terminal this alone is an important item. A decided decrease in the cost of boiler repairs, due to the reduction in flue leakage, broken staybolts and cracked firebox sheets, has been observed since the system was installed. Another important benefit is the saving in time required to turn engines. From two to three hours less time per engine is required than with the old method of washing and filling with cold water.

The system is shown diagrammatically in one of the illustra-

tions placed at such a height that the blow off line has a very appreciable pitch downward from the blow off main in the roundhouse, thus effectively draining this line of all condensation. The water flows from the blow off tank into the sludge tank, slowly passes up through the settling tank, and overflows into the washing tank. It is impossible for steam to pass into the washing tank, because the drain pipe from the blow off tank is always submerged in about 10 ft. of water. A suitable valve is provided for discharging sediment collected in the sludge tank. The pumps take water from the washing and filling tanks through 8 in. suction lines, the level of the water in these tanks being high enough above the pumps to give a good head. A thermostatically controlled valve admits sufficient cold water to the suction line of the washing pump to cool the water to a temperature of about 125 deg. Fahrenheit. The temperature of the water in the washing and filling lines in the roundhouse is kept constant by means of the small circulating lines. Steam separated from the water in the blow off tank passes to the feed water

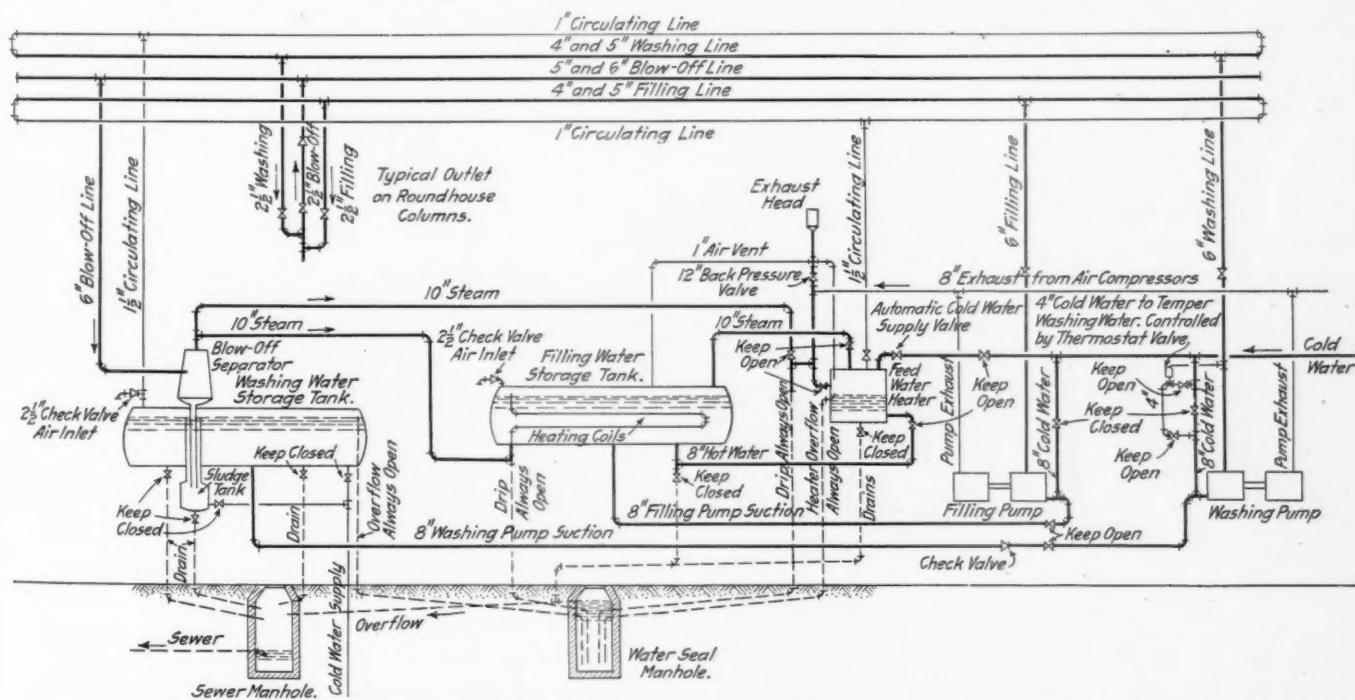


Diagram of the Hot Water Boiler Washing and Filling System at the Clifton Forge Roundhouse of the Chesapeake and Ohio

tions. The principal elements are a conical blow-off tank, 3 ft. 6 in. in diameter at the top, 5 ft. in diameter at the bottom and 7 ft. high; one washing tank and one filling tank each 8 ft. in diameter, 30 ft. long and having a capacity of 10,000 gal.; a 3,000 horsepower open type feed water heater; a sludge catch basin; a water seal manhole, and two 16 in. by 10 in. by 12 in. duplex pumps, one for washing and one for filling. The piping system between pump room and roundhouse consists of a 6 in. washing line, a 6 in. filling line, a 6 in. blow off line and two circulating lines. Drop lines of 2½ in. pipe are connected to the blow off, washing and filling mains between stalls. These three lines are brought down the building columns and arranged for hose connections.

Water and steam from the locomotive boilers pass to the blow off tank where, aided by the centrifugal force, the steam is separated from the water. The blow off tank is

heated through a 10 in. pipe. Uncondensed steam from the heater passes on to the filling tank through a 10 in. pipe, where it is utilized in maintaining the temperature of water in this tank. Exhaust steam from the air compressor which is not used for other purposes, together with the exhaust from the washing and filling pumps, and steam from the blow off tank, are collected in a common pipe line and made available for heating water not only for use in filling locomotive boilers, but for feeding the stationary boilers as well. Any oil in the exhaust from the air compressor is removed by an oil separator in the exhaust line. The feed water heater is provided with an auxiliary oil separator, which tends to remove any trace of oil still remaining in the steam. A portion of the steam from the blow off tank is discharged through a 10 in. pipe to the bottom of the filling tank. In this tank is a bank of six 4 in. pipes running twice the length of the tank, with their free outlets about 4 in. above the maximum

water level in the tank. The function of these pipes is to maintain, or still further increase the temperature of the water in the filling tank.

Water for filling locomotives, as well as feed water for the stationary boilers, is obtained from the filling tank, which is supplied from the feed water heater through an 8 in. pipe. The steam pressure in the filling tank and the feed water heater is equalized by a 10 in. pipe, hence the level of the water in the filling tank and feed water heater is the same.

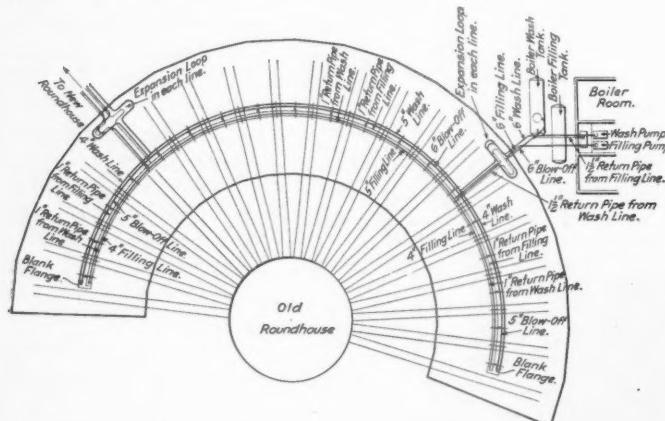


Diagram of Piping Between Boiler Room and Roundhouses

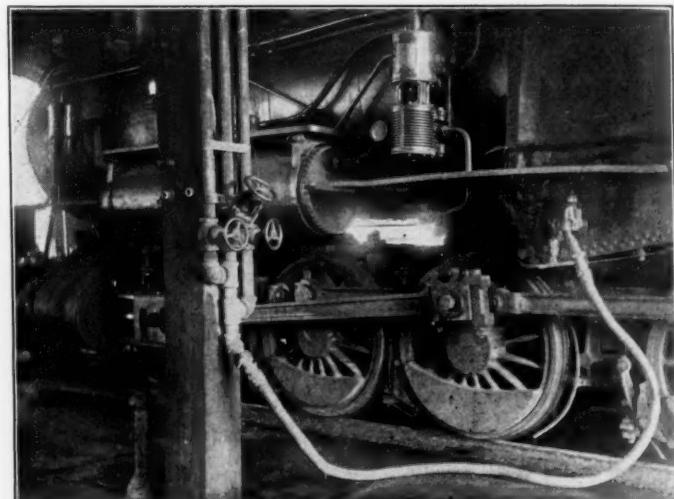
The supply of fresh water to the filling tank is controlled by a float valve in the feed water heater.

The shop boiler blow off is connected to the blow off tank and the shop boilers are washed with hot water furnished from the washing tank. Suitable drains and blow offs are provided, however, to isolate the boiler washing system from the power house piping system when so desired.

The function of the water seal manhole is to give a free outlet for all drips and overflows while maintaining a suffi-

of the equalizing action of the constant steam supply and to overcome any difficulties which might arise through an unusual sequence of the operations of blowing, washing and filling.

The system has sufficient capacity to permit nine operations to be carried on simultaneously. Three engines can be washed, three engines can be filled and three engines can be blown down at the same time. Liberal pipe sizes have been used in all cases, which enables all of the operations to be carried on with despatch. The time required to blow down a consolidation engine, with a boiler capacity of 2,115 gal., and 60 lb. steam pressure, was found to be 35 minutes. This time could be reduced practically one-half by using the second blow off. The time required to fill this boiler to one gage was 12 minutes, the temperature dropping from 210 deg. Fahrenheit at the start to 206 deg. at the finish. The boiler of a Mallet type engine having a capacity of 5,025 gal. was blown down from one gage of water at 125 lb. steam pressure in 55 minutes. It required 12 minutes to fill this boiler to one gage, at a starting temperature of 208 deg. and a

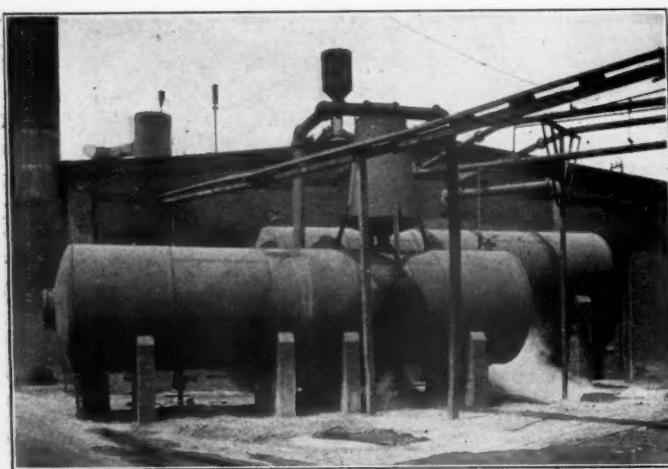


Arrangement of Drop Lines Between Roundhouse Stalls

finishing temperature of 195 deg. Another boiler was being filled at the same time.

With this system blowing down is accomplished with no evidence of steam or noise in the roundhouse, and the cost of boiler washing has been decreased. Some saving has also been effected by using the hot water from this plant for washing the machinery of the locomotives.

This system cost completely installed approximately \$11,000, and the cost of up-keep has been practically nothing since its installation. It was designed and installed by Westinghouse Church Kerr & Company, New York.



Blow-Off, Washing and Filling Tanks

cient pressure on the exhaust steam to make it available for heating buildings. This feature is, however, not in use at present.

The washing and filling pumps can be used to pump from the supply main directly into the hydrant line if it is desired to increase the water pressure in case of fire. Only the suction connections for this purpose are shown in the diagram.

It has been found that the locomotives practically furnish sufficient hot water for boiler washing purposes, and that sufficient steam is liberated to heat all the fresh water needed for filling boilers. Connection to the engine room exhaust mains has been made, however, in order to take advantage

POWER OF MACHINERY IN GREAT BRITAIN.—Mr. W. Pares, at a public meeting, lately held at Birmingham, stated in proof of the increase of the powers of production by the improvement of machinery, that in 1792, the machinery in existence was equal to the labor of ten millions of laborers; in 1827, to 200 millions; and in 1833, to 400 millions. In the cotton trade, spindles that used to revolve 50 times in a minute, now revolve in some cases 800 times in a minute. In one mill at Manchester there are 136,000 spindles at work, spinning one million two hundred thousand miles of cotton thread per week. Mr. Owen, of New Lenark, with 2,500 people, daily produces as much cotton yarn as will go round the earth twice and a half. The total machinery in the kingdom is calculated now to be equal to the work of 400 millions, and might be increased to an incalculable extent under proper arrangements.—*Extract from the Birmingham Journal in the American Railroad Journal, February 6, 1835.*

OBSERVATIONS ON APPRENTICE SCHOOLS

BY ROBERT W. ROGERS

Apprentice Instructor, Erie Railroad, Port Jervis, N. Y.

An apprentice instructor should have unlimited patience and be enthusiastic about his work. It is this enthusiasm which is instilled into the apprentice that keeps up the fighting spirit of the boys and makes them determined to master their tasks. No boy should be employed who smokes cigarettes or uses intoxicating liquors. A railroad wants men with steady nerves and clear brains, so it begins with the boys. While a thorough knowledge of the trade is necessary for the instructor, yet if he leads the boy to be morally clean, honest, truthful and loyal to his employer, the latter will attain confidence in his own ability and a determination to do right, and will learn to do his work well. The formation of apprentice clubs for healthy amusements is to be commended.

Many railroad officers have given the apprentice school their endorsement and are interested in the development of the work. In many cases, apprentice instructors have made good workmen out of boys whom a foreman would have discharged. Where boys can be secured who have had one or more years in high school, the instructor does not need any special training for instruction in mathematics or even the elements of drawing; but where the boy has had but an elementary school education, an instructor should have a liberal education in order to instruct in the various elements of arithmetic at least, and to explain correctly and clearly the various problems in connection with shop work. There is no doubt that great benefit would result by changing the instructors about from time to time, or even detailing one instructor to lecture on a subject in which he is particularly well versed, as, for instance, tool making, gas engines, or electricity. We each have a natural inclination for some one or two subjects, so one instructor may excel along one line and another along a different line; thus a change would benefit the apprentices in more ways than one.

In giving instruction in electrical work, it is well to keep away from mathematics except for the simplest problems, because the more complex problems of alternating currents require a more thorough knowledge of mathematics than any high school or night school can give.

Much has been written concerning the selection of an ap-

to try the trade out; no one knows how he will like the work until he tries it.

The work of apprentices is often handicapped by the lack of facilities. A separate department containing a lathe, a shaper, a drill and a small planer could at most plants be set aside for the apprentice to work on under the supervision of the instructor. After six months at such work, the apprentice would be ready to go in the shop for work under the various foremen. In shops where no erecting work is done, a small locomotive could be supplied for the apprentices to work on, performing such work as stripping and assembling, checking valve motion, lining shoes and wedges, and guides. This would tend to offset the lack of an erecting shop.

The idea of laying off an apprentice the same as a helper seems rather crude; in fact, it is contrary to the object set forth in hiring a boy to teach him his trade. This is the reason so many boys quit even after serving one year; they are treated, not as wards of the company, but simply as cheap laborers. It is a short-sighted policy for any railroad to treat the prospective machinist, boilermaker or blacksmith in such a manner.

That this is an age of specialists holds true for the apprentice. It is the duty of an instructor to watch his apprentices carefully and discover a boy's natural bent and do all he can to further his work along the lines for which he proves best fitted. The men and the company will gain much by having a few experts, rather than numbers of jacks of all trades.

No apprentice school is complete without a lantern for projecting on a screen illustrations of the various parts or objects under discussion. This lantern should be supplemented by charts on the work in the various shops, as these add to the effectiveness of the lecture and save time in instructing.

REPAIRING AIR PUMP GOVERNORS

BY J. A. JESSON

The tools for repairing the diaphragm portion of Westinghouse pump governors, which are shown in the engraving, were made from the designs of the author at the South Louisville shops of the Louisville & Nashville.

When the seat of the diaphragm valve becomes worn, to restore it to its original condition it is necessary to enlarge and plug the port hole and make a new seat. Fig. 1 shows the old port drilled and a brass plug *B*, $\frac{1}{4}$ in. in diameter and $\frac{3}{16}$ in.

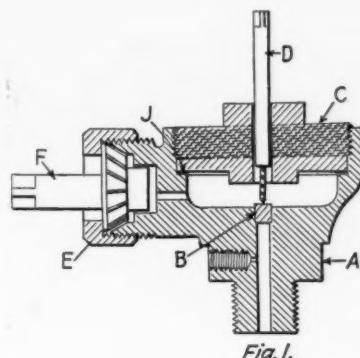


Fig. 1.

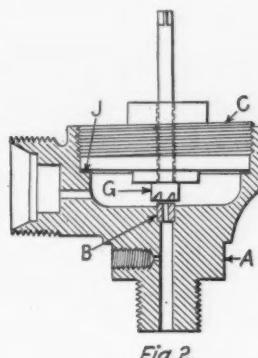


Fig. 2.

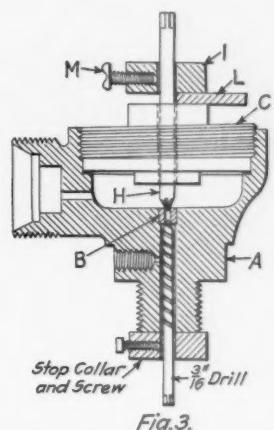


Fig. 3.

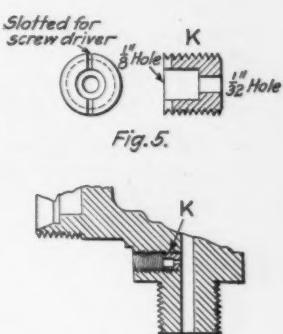


Fig. 4.

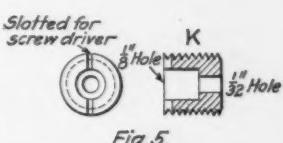


Fig. 5.

Repairing the Diaphragm Portion of Westinghouse Air Pump Governors

prentice, but no one can tell whether a boy will make good by simply looking at him and making a casual investigation of his educational fitness. A boy should, of course, be made to pass certain requirements, but under the present laws in various states it becomes practically impossible to hire a boy under 16 years of age, and few boys at that age have not had at least some school training. It is advisable to give a boy about six months

long, driven in. The jig *C* pilots the drill *D* in drilling a $\frac{1}{8}$ in. hole through the plug *B*. Fig. 2 shows a facing reamer *G* fed by the jig *C*. The thickness of the reamer body is such that when enough stock is removed from the plug *B*, the jig will engage the shoulder at *J*. This operation squares up the seat and leaves it the right height.

Fig. 3 shows the jig in position for operating the valve seat

reamer H . The reamer is dropped against the plug B , a disc L , 0.018 in. thick is placed between the jig C and the collar I ; a set screw M tightens the collar I , and the disc is then removed. The reamer H is then turned until the collar I engages the jig C ; by this means a definite bearing is secured. A 3/16 in. drill, provided with a stop, is run in from the lower end of the diaphragm body, its purpose being to maintain the correct length of $\frac{1}{8}$ in. bore for port hole.

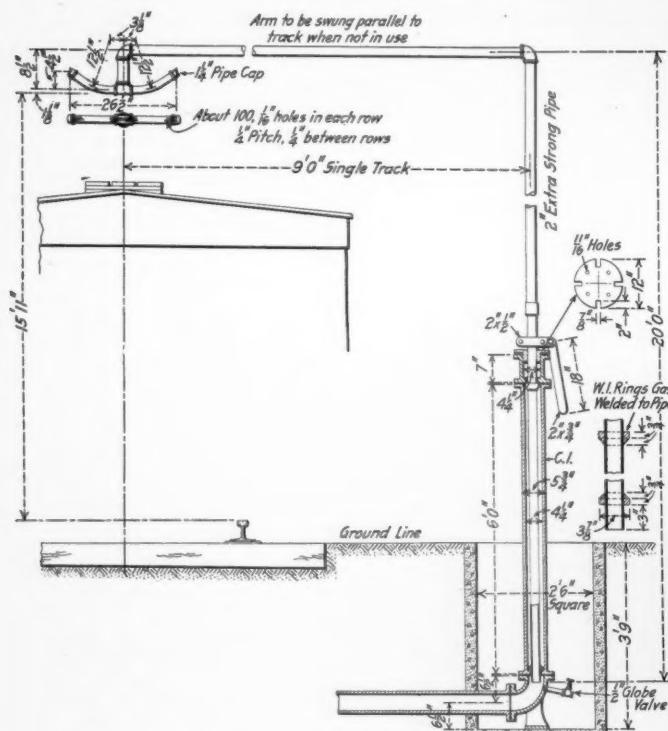
Figs. 4 and 5 show the method of renewing the vent port. A short $\frac{1}{4}$ in. brass plug K , threaded and drilled as shown in Fig. 5, is screwed into the vent port tapping. A center punch is driven into the $\frac{1}{8}$ in. hole of the plug K , setting it out and securing it from loosening.

In Fig. 1 a beveled reamer F is shown in position for truing the union joint bearing. The reamer is fed by the nut E .

TESTING CAR ROOFS FOR LEAKAGE

The device shown in the engraving is in use at the Topeka shops of the Atchison, Topeka & Santa Fe for testing the roofs of box cars for leakage. It is arranged in the form of a stand pipe located at the side of the track, or between two tracks, and has a spray delivery which can be swung over the center line of the track. When not in use it can be swung to one side out of the way.

The construction is clearly shown in the illustration. A flanged cast iron pipe 6 ft. long and $4\frac{1}{4}$ in. inside diameter is bolted to the top flange of a cast iron elbow, the side flange of which is connected to the water main. The lower flange of



Swinging Crane for Testing Car Roofs for Leaks

this pipe extends inside the bore to a diameter of $2\frac{1}{2}$ in., thus forming a step bearing for the 2 in. extra strong pipe of which the swinging member is composed. A gland casting is bolted to the top flange of the 6 ft. pipe, the bottom flange of this casting forming a bearing for the vertical stop collar on the 2 in. pipe.

The nozzle is arranged to deliver a fan shaped spray which will reach practically all points across the roof of the car, the cars to be tested being drawn slowly underneath the crane. The device is being operated on the regular water main pressure, of 100 lb. per sq. in. The cost of installation is small and arrange-

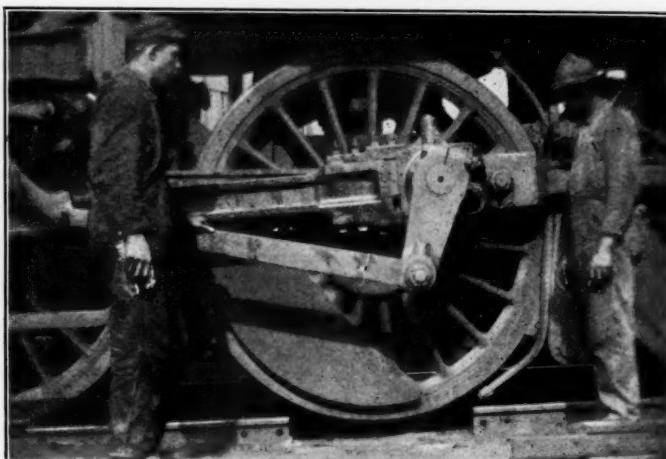
ments have been made to place similar devices at various points on the system where heavy repairs are made to freight cars.

SPRING RIGGING AND TIRE REPAIRS

BY J. S. WILLIAMS
General Foreman, Chesapeake & Ohio, Charlottesville, Va.

The maintenance of spring rigging and tires on heavy locomotives gives the average roundhouse foreman considerable concern as to the quickest and cheapest method of handling the work, as it is essential that engines be repaired and returned to service as quickly as possible in order that no delay can be traceable to the mechanical department.

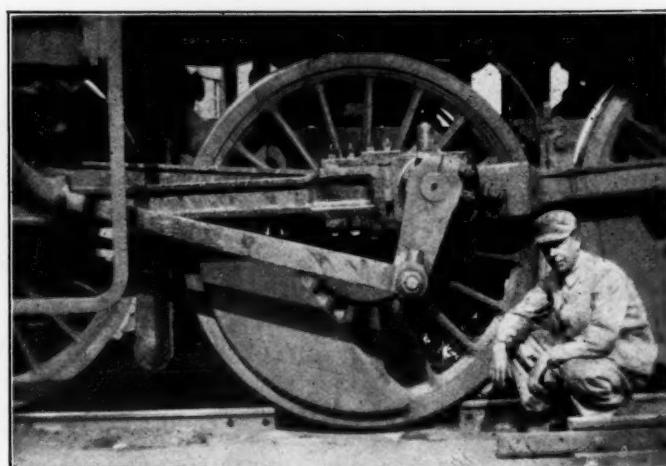
The problem of handling such repairs has been solved in a simple and inexpensive manner at Charlottesville, by placing



Driving Wheel in Position for Tire Work

two drops in the rails of one of the roundhouse pits. This is accomplished by removing from the pit track 36 in. sections of rail located under the front and back drivers. With the drops so located, any pair of wheels under a locomotive can be placed over one or the other. The short sections of rail, when not in use, are held in place by a $1\frac{1}{4}$ in. by 3 in. strap, bolted with 1 in. bolts.

All spring rigging and tire work is done on this pit. When



Driving Wheel in Position for Applying a New Spring

it is necessary to renew a driving spring, the wheel is first run up on a wedge, and blocking placed under the spring rigging in order to relieve the load on the spring which is to be removed. After this the wheel is run off the wedge, the 36 in. section of rail is removed and the engine is moved so the wheel will drop.

into this space, relieving the spring entirely of its load, so that it can be removed and a new one applied without the use of bars or spring pullers.

When it is necessary to change, tighten or re-set a driving or trailing tire, blocking is first placed between the bottom brace of the frame and the journal box. This holds the wheel in its original position, while the short section of rail is removed and the engine is moved so the wheel will come directly over this space, leaving the entire circumference free.

With the adoption of this method of handling this class of repairs, we have entirely eliminated the practice of jacking engines, at the same time reducing the expense for labor 50 per cent, and returning locomotives to service considerably quicker than when the old method was followed.

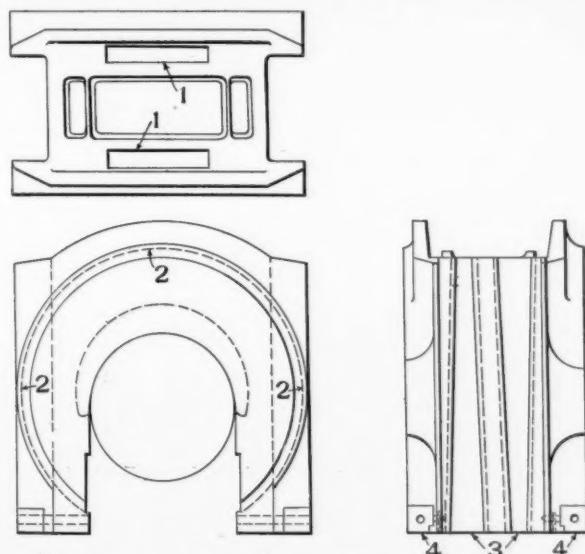
RECLAIMING CAST STEEL DRIVING BOXES

BY H. C. SPICER

Gang Foreman, Atlantic Coast Line, Waycross, Ga.

It has been found practicable in the Atlantic Coast Line shops at Waycross, Ga., to refit cast steel driving boxes after they have become badly worn, so that they are again available for considerable service.

If the slots shown at 1, which form the seat for the spring saddle, are worn they are milled out on a key seating machine and a spring steel plate fitted in to bring them back to proper size. The hub face of the box is faced and dovetailed $\frac{1}{4}$ in. to $\frac{5}{16}$ in. deep at 2, and the crown and hub brasses are poured in one operation. This makes an economical way of building up the hub side of the box when it is worn and saves consider-



Operations in the Reclaiming of Cast Steel Driving Boxes

able time and labor in the turning and fitting of the crown brass. It is believed that this operation could be well adapted to new boxes as well as old ones. Two wedge shaped slots are dovetailed on the shoe and wedge fits as shown at 3 and brass poured in to form a liner. The boxes can thus be brought up to the original size for the shoe and wedge fit. If the cellar bolt holes are broken out at the corners at 4, the corners of the box are planed off and plugs fitted to them and fastened in by $\frac{1}{4}$ in. dowels.

FOOLISH QUESTION No. ——“What elevation per mile, may be considered, with locomotive power, equivalent to an additional mile on a level road?” Will some of our railroad friends, who have more leisure than we, please answer the above query?—Editor.—From the American Railroad Journal, March 7, 1835.

CROWN SHEET EXPANSION STAYS

BY N. H. AHSIUOLH

The subject of crown sheet stays adjacent to tube sheet flanges, has been given much consideration in the past few years in an endeavor to correct existing defects in locomotive fireboxes. As a result of these defects, the renewal and patching of tube sheets form very considerable items of expense in firebox maintenance. Having had extensive experience with nearly every type of crown sheet stay, the writer will endeavor to show wherein lie the weaknesses of each type, and suggest a method of staying to eliminate tube sheet failures.

First, considering the standard T bar construction as shown in Fig. 1, it is always found when necessary to remove T bars of this construction after a period of service of from four to eight years, that the bolts, bars and sling connections are all in one solid mass. Scale has formed around the slings and sup-

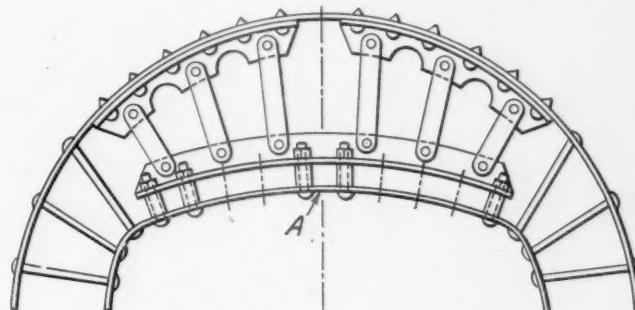


Fig. 1—Standard Crown Bars In Radial Stay Boilers

porting bolts and nuts, making it very difficult to remove them from the boiler. This fact of scale formation will prove the absence of flexibility, or any possible adjustment of this construction to the various movements of the crown sheet due to tube sheet expansion and contraction. The deterioration of the top flanges of tube sheets is caused by the rigidity of T bar construction, which confines the resultant stresses set up by the expansion of the tube sheet, to the short space between the top tube holes and the center line of the first transverse row of crown supporting bolts, as at C, Fig. 2. Where these stresses are distributed over a wider area of the crown sheet the deterioration of the tube sheet knuckles is not evident.

At the highest point on the top tube sheet flange, which lies

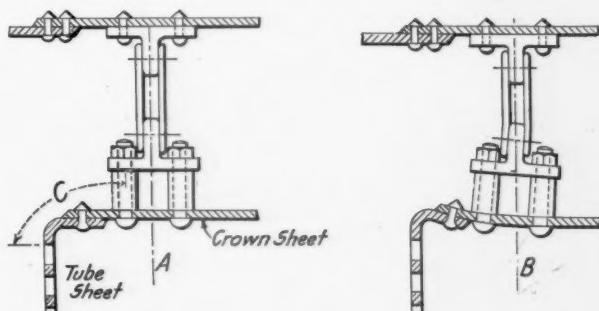


Fig. 2—Effect of Rigid T Bar Construction

on the vertical center line, is where the first distortion due to expansion takes place, extending toward each side as distortion progresses. This can be proven in a Belpaire boiler, having expansion crown stays as in Fig. 3, where the distortion of the tube sheet is always greatest in the center, gradually decreasing to nothing at the sides. Also by holding a short straight edge against the vertical web of the T bar at the center, a very decided deflection of the bar toward the backhead will be noted, especially where the top tube sheet flange is badly distorted. This is shown at B in Fig. 2.

By rigidly bracing a crown T bar to and equidistant from the

crown sheet throughout its entire length, we secure the crown sheet so that, theoretically, no movement can take place at the center of the sheet unless a corresponding movement takes place under the entire length of the T bar. As the first compressive strains are communicated to the crown sheet in the center, the sheet under the entire length of the T bar receives corresponding strains much sooner than it would if not rigidly braced to the T bar. The foregoing statements will show that the flexibility of movement sought for is defeated by this construction.

Another very serious defect arising from this method of staying is the sagging or pocketing of crown sheets under the ends of T bars, as shown at *B* and *B'* in Fig. 4. There are three causes for this condition:

1. The application of thimbles or nuts between the crown sheet and the under side of the T bars;
2. The backward twist of the center of the T bar as previously

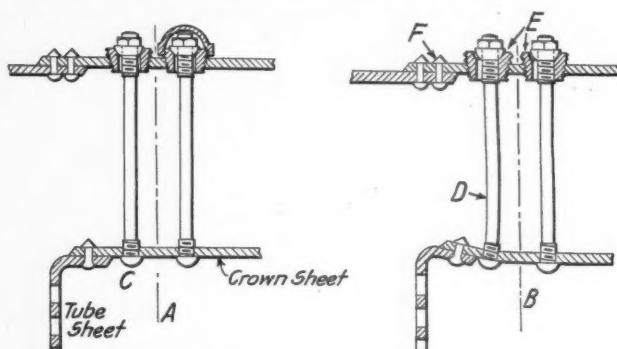


Fig. 3—Expansion Crown Stays in a Belpaire Boiler

mentioned, which causes a forward and downward thrust of the ends of the T bar;

3. The fact that the T bar is an independent factor and its expansion and contraction in length are not controlled by, and have no connection with the relative expansion and contraction of the outside and inside firebox sheets.

The outside and inside firebox sheets being rigidly stayed, do not relatively change position due to expansion and contraction. For the same reason the T bar does not change position vertically. Horizontally it does expand and increase in length as there is nothing to prevent it from so doing. The sling stays *F* and *G* in Fig. 4, being radially applied, do not retard this movement. The T bar being curved, the expansion will follow the line of curvature and the resultant lengthening of the T bar will bring it closer to the sheet at the ends than at the center,

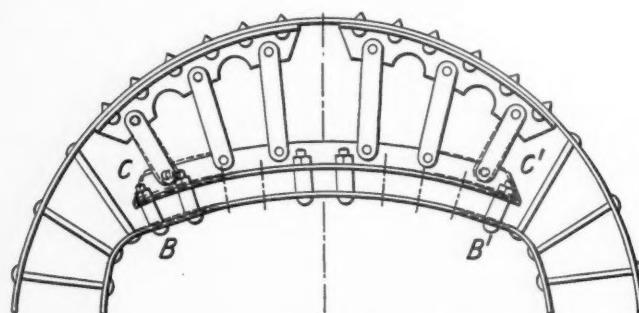


Fig. 4—Standard Crown Bars After a Period of Service

as at *C* and *C'*, Fig. 4. With each repeated firing of the boiler the bar lengthens and comes closer to the sheet. If there are thimbles around the end crown bolts, the sheet is forced down and bulges toward the fire.

In proof of these statements, we find when applying to a new firebox the exact counterpart of the old one when it was new, a T bar removed from an old firebox, that the end holes do not line up with the holes in the firebox, and also that the radius of the T bar has changed. The T bar must be heated and the ends

raised to make it conform to the curve of the new crown sheet. This situation clearly shows that the ends of the bar have come down; also that the bar has become longer while in service.

To eliminate the sagging of crown sheets, the writer has practiced the slotting of three end holes in each row of holes, $1\frac{1}{2}$ in. long for 1 in. bolts, then applying these three end bolts without thimbles between the T bar and crown sheet, as shown in Fig. 5.

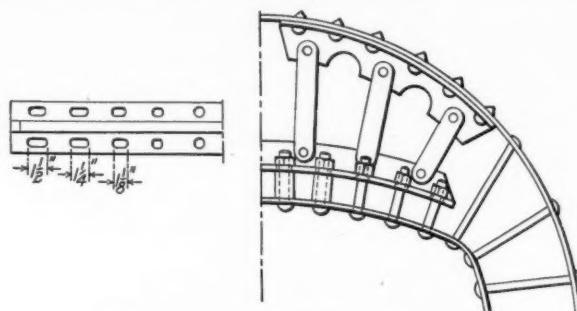


Fig. 5—Eliminating Crown Sheet Sagging

Crown sheets with bars applied in this manner run four years without sagging or bulging of sheets, whereas bars applied with thimbles around all bolts will cause sheets to sag from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. within three years' service in the same districts.

In making comparisons of the two methods, a peculiar condition presents itself. Whereas a crown sheet will sag in engines with thimbles around the end bolts from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in three years' service, in engines having slotted holes in the bars and no thimbles around the end bolts, it is barely possible to insert a knife blade between the crown bolt nut and the face of the T bar, and the sheet has not sagged.

While this practice has eliminated the sagging of crown sheets, it has had no noticeable effect on the deterioration of flue sheet knuckles, the same defects existing with either method.

Next let us consider the eyebolts shown in Fig. 6. Eyebolts in outside and inside firebox sheets, connected by sling stays,

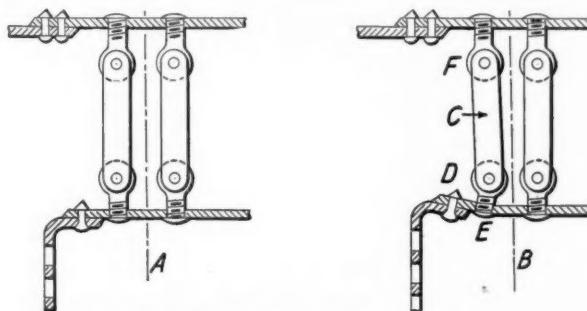


Fig. 6—Illustrating the Action of the Eyebolts

have been used quite extensively in an endeavor to eliminate defects at the top tube sheet flange. When this arrangement is properly applied with all parts in tension, which is not always the case, we have, after a time, conditions as shown at *B*, Fig. 6. The edge of the crown sheet, curling back as a result of the upward movement of the tube sheet, will cause the top of the bottom eyebolt to move in a backward direction. When this movement first begins the supporting sling *C*, Fig. 6 becomes loose, but as distortion of the sheet progresses it gradually becomes tighter, the line from *E* to *F* becoming the hypotenuse of the triangle *EDF*, of which the slingstay and bottom eyebolt form the other two sides. The rigidity thus produced prevents flexibility of movement, and produces the same defects in the top tube sheet flange knuckles that are found with the T bar construction.

Fig. 3 illustrates the application of sleeves in the outside firebox sheet, through which the crown bolts are applied. The bolts have nuts and washers on the top end, and button heads at the crown sheet end. This arrangement has been in use in the Bel-

pair of boilers of an Eastern road for upward of 15 years, and with the exception of the style of nut and washer, is exactly the same arrangement now being extensively installed in radial stayed boilers.

As tube sheet expansion progresses, with this method of staying the crown sheet is curled up as shown at *B* in Fig. 3. The crown bolts in the first transverse row nearest the vertical center line as at *C*, Fig. 3, are forced backward causing the back end of the top of bolt to ride hard against the sleeve as at *E*. In these particular engines the sleeves were made of brass, and the bolts sunk into the sleeves to the depth of the threads. Further travel of the tube sheet upward caused the bolts to bend as at *D*.

This arrangement allows stresses set up by tube sheet expansion to spread over a larger area than any type so far dis-

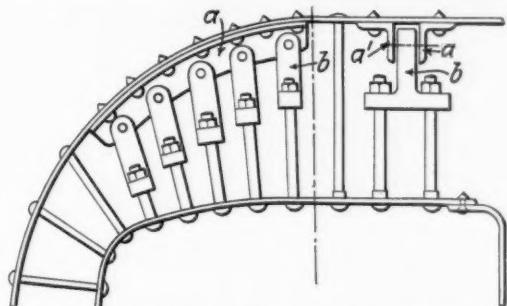


Fig 7—A Type of Construction Used in Radial Stay Boilers

cussed. As a result of wider distribution of stresses, there was no deterioration of the top tube sheet knuckles evident; also there was never any sagging of crown sheets. The writer has repaired hundreds of boilers containing this type of crown stay, in many of which the distortion was so great that the tube holes were on a line with the rivet heads in the flanges, making it impossible to expand the tubes in a proper manner, yet the top flange knuckles of these tube sheets were in perfect condition, no cracks or defects of any kind, outside of the distortion in shape, ever having been noticed.

A very serious drawback to this construction is the fact that the vibratory strains of the tube sheet expansion are communicated to the outside sheet, which causes cracks to start through

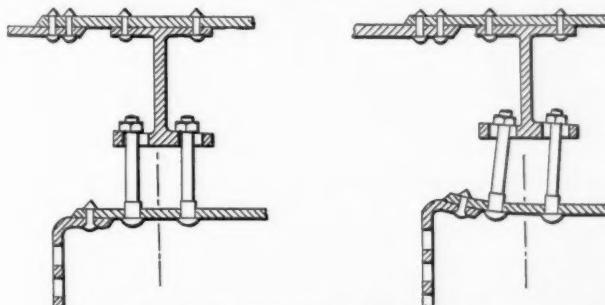


Fig. 8—Recommended Construction

the center of the rivet line shown at *F*, Fig. 4. These cracks always develop at the vertical center line first, and travel toward each side as distortion progresses. This is caused by the threads on the crown bolts sinking into the brass sleeves and communicating the vibration of the tube sheet to the roof sheet. In from three to five years' service it is always necessary to apply patches to repair these cracked sheets.

Another defect of this construction is the fact that the greater the deflection of the bolts backward, the less tension there is on the bolts when the boiler is under pressure. These same defects will develop in an arrangement now being extensively applied to radial stayed boilers. In this case iron sleeves are used instead of brass, and ball joint nuts are used in the sleeves instead of flat nuts and ball joint washers. There is no doubt that tube sheet deterioration will be very materially reduced, and on ac-

count of outside sheets being circular there will be no cracks in these sheets. The fact remains, however, that after the sheets have become distorted, the bolts will never be in tension when the boiler is under pressure.

A construction used by the railway previously referred to, in their radial type boilers, is shown in Fig. 7. Angle irons *A* and *A'* are riveted to the outside sheets, and crowfeet *b* hung from them, the crown bolts being secured to the crowfeet as shown. The longest bolts are adjacent to the vertical center line, where the strains resulting from distortion of the tube sheet are taken care of by the ability of the crowfeet to move slightly, and the bolts to bend slightly and ride hard against the back of the holes in the crowfeet. This construction eliminates cracked tube sheets and there are no sagged crown sheets, but the same absence of tension in the bolts when the boiler is under pressure is in evidence.

The foregoing illustrates practically every construction extensively used to stay the crown sheet at the tube sheet flanges. There are serious drawbacks to every one, the most serious being the absence of tension on the bolts after distortion has taken place. This may be an important factor, contributing to the dropping of crown sheets due to low water. Bolts or braces which are not always in tension should never be applied to crown sheets.

The application of more than two transverse rows of any kind of bolts to provide flexibility of sheets is an error. It will be plain after a study of the sketches in this article, that the crown sheet could not move vertically at the third or fourth transverse rows of bolts, without stretching at the side roll.

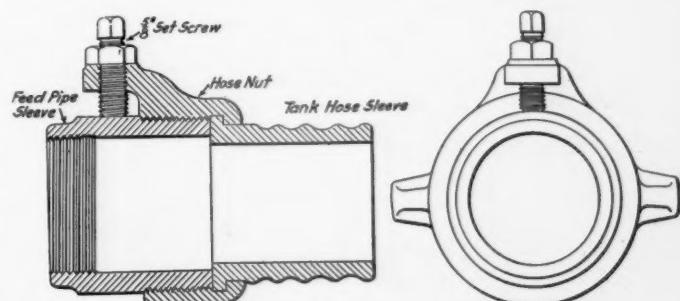
Fig. 8 represents the writer's idea of a construction which will eliminate defects now existing. It consists of an I bar, cast with slotted holes, to allow the crown bolts to move as shown. By this construction the advantages of other arrangements will be retained, and the bolts will also be in tension all the time while the boiler is under pressure.

In conclusion, the writer believes that the entire subject will become clearer in the minds of those interested whenever the idea becomes more prevalent that, while the tube sheet does move upward, the bolts in the crown sheet do not. The crown sheet curls upward and backward, and the top end of any bolt tapped at a right angle through the crown sheet must move at a right angle to the movement of the crown sheet, or backward and downward. All types of crown staying used are based on the theory that the top ends of crown bolts move upward as a result of tube sheet expansion. This is entirely wrong and can be readily proved so by the use of diagrams.

CHECK NUT FOR HOSE CONNECTIONS

BY CHAS. MARKEL

In order to prevent the hose nuts between the engine and tender becoming loose and working off, allowing the water to be lost from the tender before the engine crew discovers it, the de-



Check Nut for Tank Feed Hose Connections

vice shown in the illustration was developed by the author. A projection or lug is cast on the hose nut and is threaded for a set

screw; after the hose nut is properly tightened, the steel cupped set screw is set tight against the feed pipe sleeve and the jam nut against the set screw, thus preventing the hose from becoming separated.

DEVICE FOR BENDING MEAT HOOKS

BY J. LEE

The machine whose construction and operation are shown in the accompanying engravings, was designed to reduce the cost of manufacturing meat hooks used in refrigerator cars. It is air operated and forms both ends of the hook in one operation,

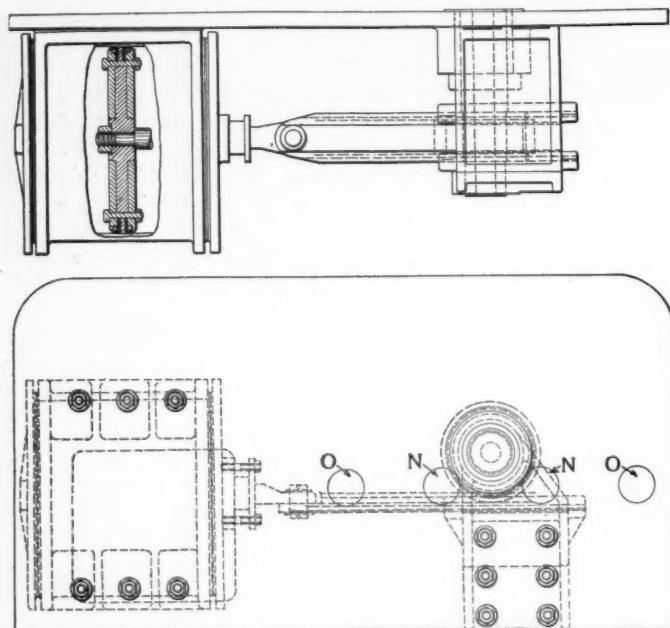


Table and Cylinder of Device for Bending Meat Hooks

the metal being worked cold. Before it was installed the hooks were bent hot by hand, each end being worked separately over a die.

The machine consists of a table, to the under side of which are

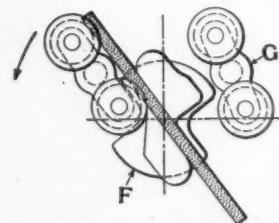


Fig. 1-Beginning of Stroke.
Start of Bend on 1st. End.

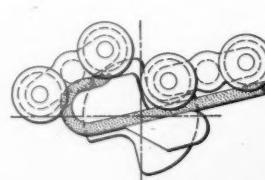


Fig. 3.
Start of Bend on 2nd. End.

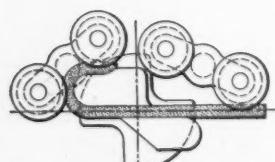


Fig. 2.
Finish of Bend on 1st. End.

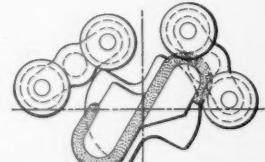


Fig. 4-End of Stroke.
Hook Completed

Operation of Die and Rollers

secured an air cylinder and a bearing for the operating spindle, which extends through to the top of the table. A rack working in a guide secured to the under side of the table transmits motion from the piston to a pinion secured to the lower end of the

operating spindle. Die *F* shown in Fig. 1 is keyed to the upper end of the operating spindle.

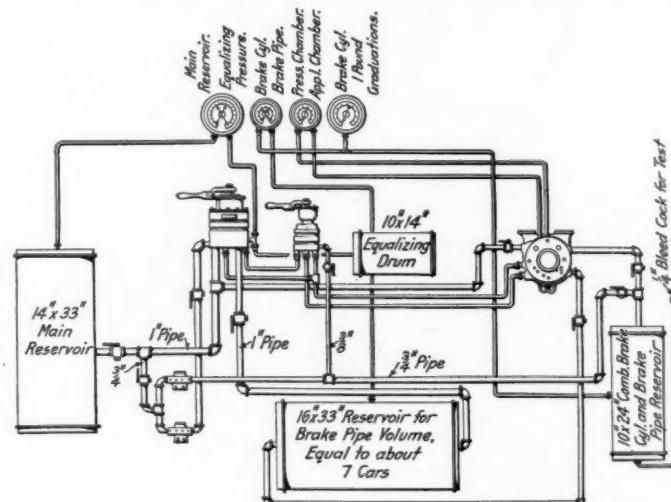
Hooks of two sizes are made, requiring different size dies. For the smaller size, roller brackets *GG*, Fig. 1, are placed in bosses *NN* shown on the engraving of the table and cylinder. For the larger size they are placed in bosses *OO*.

Figs. 1, 2, 3 and 4 show the operation of the rollers in bending the stock as the die is turned through its operating angle of about 160 deg. In using the machine, stock in large quantities is cut to length on a bolt cutter and taken by a man to a small steam hammer where the ends are pointed. The pieces are then taken by the machine operator and bent cold, ready for tinning. After passing through the tin bath the hooks are ready for shipment. The average output is 1,200 hooks per day.

PORABLE COMBINATION TEST RACK

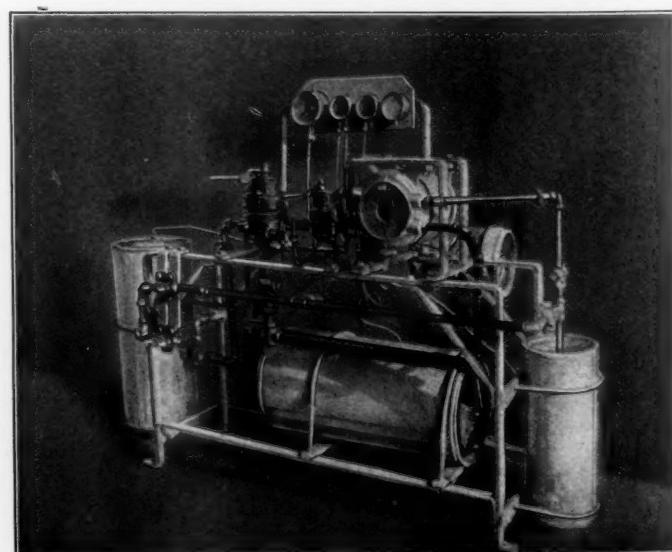
BY F. W. BENTLEY, JR.
Machinist, Butler Shops, Chicago & North Western, Milwaukee, Wis.

The increased number of operating parts used in connection with the E-T air brake equipment generally make the construction of a complete test rack somewhat difficult. The ac-



Arrangement of Details of Portable Combination Test Rack

companying illustrations show a combination test rack with cut-out cocks so located in connection with rigidly attached reservoirs, that all parts of the locomotive equipment may be placed on it and tested either collectively or separately.



Portable Combination Test Rack

The combination reservoir, so termed in the piping diagram, can be used as a brake cylinder in connection with the examination of the distributing valve, or may be utilized as a small train line volume in the examination of a feed or reducing valve, independent of the rest of the apparatus. The bleed pipe from the bottom of the combination reservoir is used for determining the sensitiveness of the feed valves in an independent test, and for ascertaining in the distributing valve test, the sensitiveness of the application piston in building up leakage.

The whole device is so arranged and built that it can be located anywhere about the shop, as it need only to be lifted clear of the floor to move it. The gage board is equipped with two extra gages, one brake cylinder or combination reservoir gage graduated in pounds, and one E-T No. 2 gage with connections direct to the application and pressure chambers in the combination drum. By this means, the independent test of a feed valve can be accurately made by the brake cylinder gage, and the condition of the graduating valve or the slide valve of the equalizing piston readily told by the action of the hands on the second No. 2 gage.

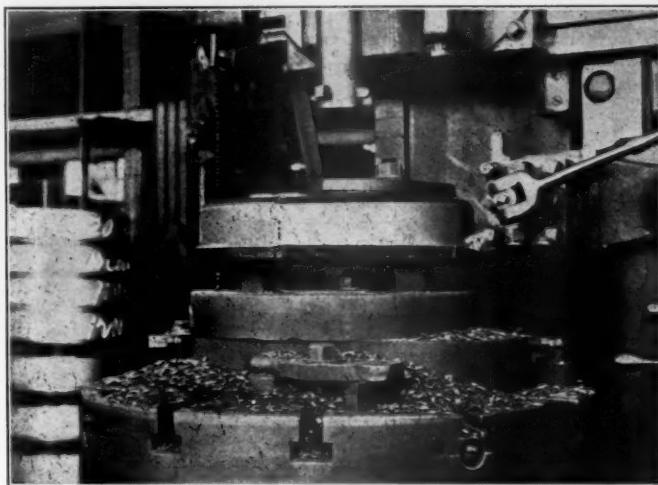
CHUCK FOR ECCENTRICS

BY C. L. DICKERT

Assistant Master Mechanic, Central of Georgia, Macon, Ga.

A chuck for boring and turning eccentrics on a boring mill with one chucking is shown in the accompanying photograph and drawing. The chuck is simple in design, and is easily ap-

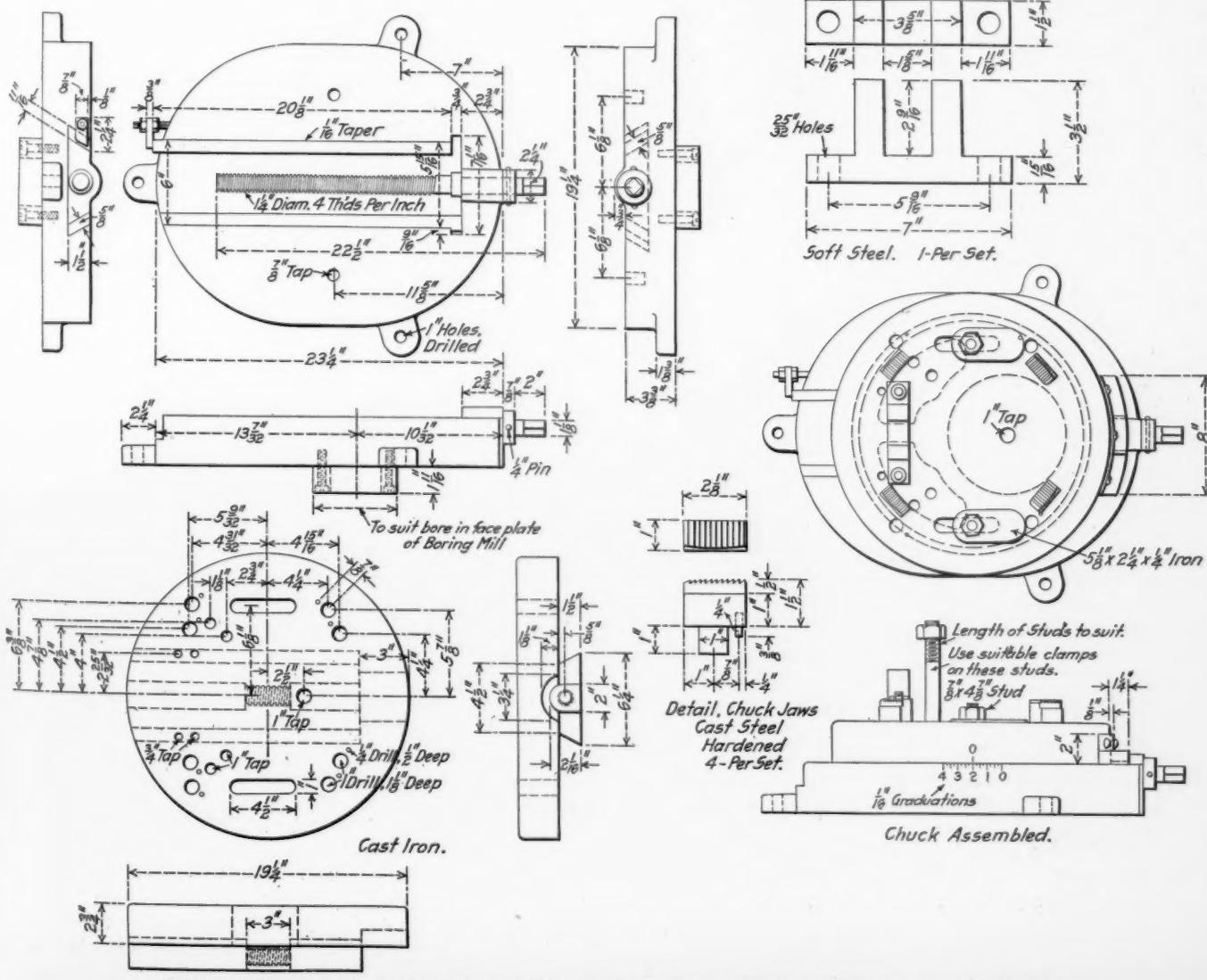
plied to the machine. The eccentrics are clamped by tightening two nuts which clamp them sufficiently to take heavy cuts. The chuck is so designed that it will take as many different sizes of eccentrics as may be desired by simply changing four grip



Eccentric Chuck Attached to a Boring Mill

blocks and two studs from one hole to another; it is also made adjustable for any throw of eccentric.

Either the boring or the turning operation can be performed



Details of Chuck Used on the Central of Georgia for Boring and Turning Eccentrics on a Boring Mill

first; no laying off of the eccentric for throw is required. Whichever operation is performed first, the chuck is shifted to obtain the desired throw by loosening two nuts and turning the screw. The driver is fastened on the center line of the chuck, and is made in a U shape to fit over the rib in the eccentric; this arrangement acts as a centering device, bringing all the eccentrics to the same center. The four saw-tooth grips, which are made of steel and hardened, are $1\frac{1}{2}$ in. high to allow clearance for tools. The dotted lines on the drawing show the position of the eccentric on the chuck with the clamps omitted.

EMERY WHEEL STAND

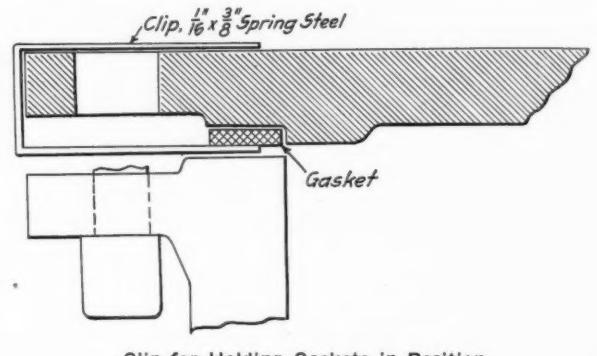
BY PAUL R. DUFFEY

The engraving shows the general arrangement and details of an emery wheel stand for general shop use. This stand will give a great deal of service before it is necessary to renew any parts. A special feature is the means employed to eliminate lost motion from the bearings. This will be seen in the arrangement of the shaft bearing bushing. The outside and inside nuts on the bushing keep it tight, and in order to adjust it so that lost motion may be taken up it is only necessary to loosen the outside nut and tighten the inner one. The $\frac{1}{8}$ in. wood strip should be a loose fit to allow for closing slightly without its being necessary to

CLIPS FOR HOLDING BRAKE CYLINDER HEAD GASKETS

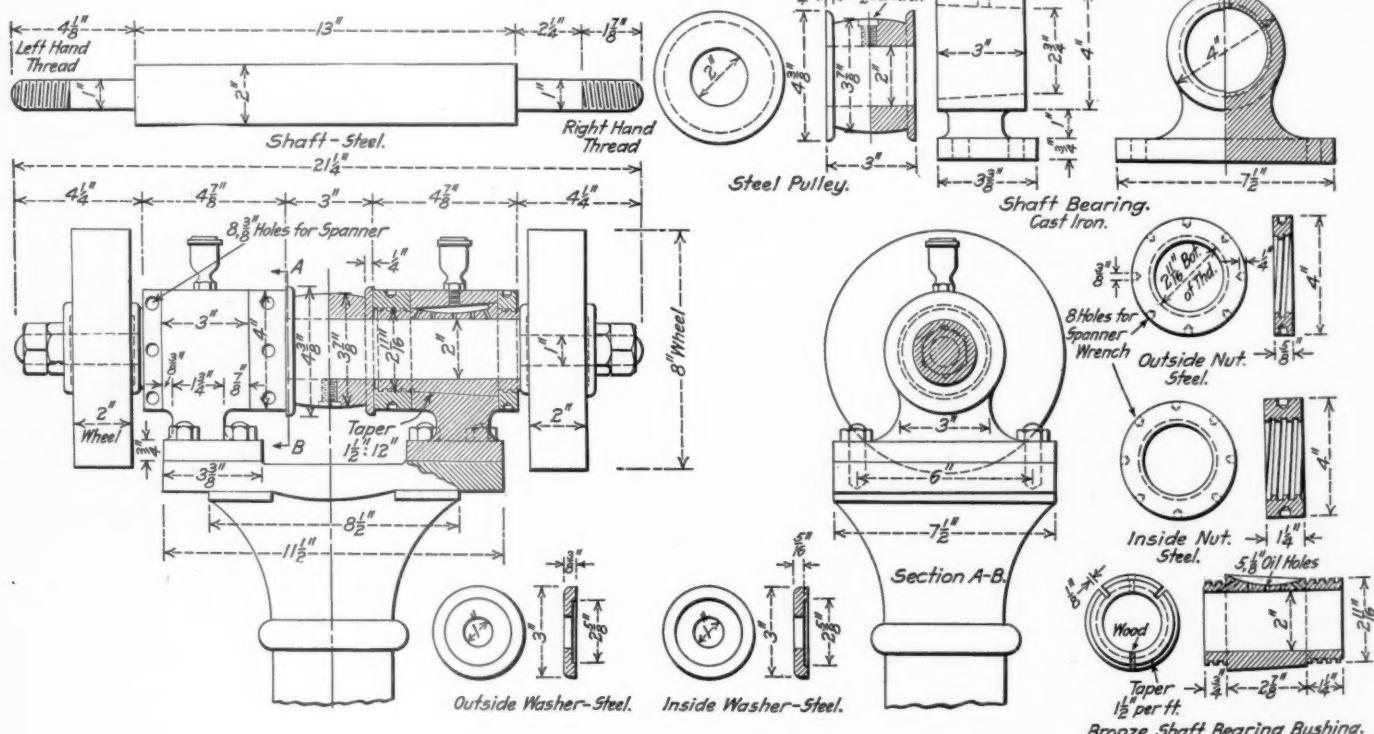
BY F. W. BENTLEY, JR.,
Machinist, Butler Shops, Chicago & North Western, Milwaukee, Wis.

Brake cylinder head gaskets are the cause of much annoyance in roundhouse work. The light, narrow gaskets give the most trouble, particularly if they are being applied with the head, to



Clip for Holding Gaskets in Position

cylinders which are placed in a horizontal position and close to the cab bracket sheets, with only 5 or 6 in. of working space



Arrangement and Details of Shop Emery Wheel Stand

remove it and replace it with a thinner strip. This type of stand has been in use for some time in several shops and has proved to be much more successful than many higher priced machines.

TUNNEL UNDER THE DANUBE.—A tunnel under the Danube is under consideration by the Roumanian government to form a connection with its newly acquired territory. A bridge was first considered, but as no protected site was to be found, military precautions forced the abandonment of the project. The proposed tunnel will have heavily fortified terminals.—*The Engineer*.

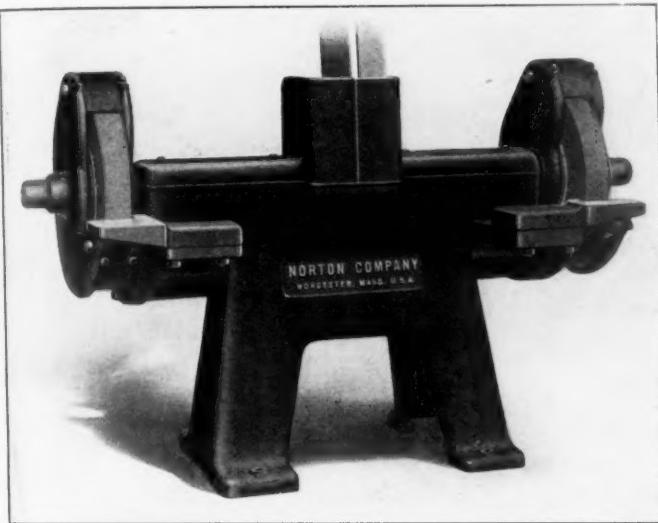
available for putting the head in place. A coating of thick white lead will in some cases keep the gasket on the joint face of the head while putting it in place, but as all gaskets are not exactly of the same diameter, due to the nature of the rubber, many of them cannot be held in place by this means.

The use of clips, as shown by the accompanying illustration, prevents trouble from the slipping of the gasket, no matter how cramped and inconvenient the working quarters may be. Two or three of these clips hold the gasket securely, and after the head has been secured by drawing up one or two of the head bolts they can be readily pulled out. A number of the clips can be carried in the top of a tool box by means of a piece of tin.

NEW DEVICES

GRINDING WHEEL STAND

A floor type grinding wheel stand completely equipped with protection and dust hoods has recently been brought out by the Norton Company, Worcester, Mass. The new design is an outgrowth of the experience of this company in the use of grinding wheels on the many types of floor stands now on the market.



Grinding Wheel Stand with Long Overhang Bearings

While it is not a radical departure from other machines now in common use, care has been taken to provide rigidity of construction, safety, convenience of operation and durability of wearing parts.

The weight and rigidity of the stand permit of a small founda-



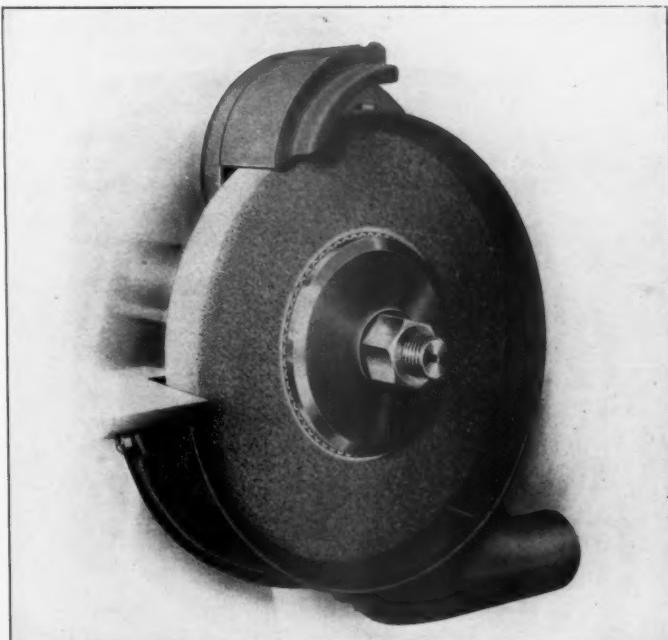
Protection Hood Covering the End of Grinding Wheel Spindle

tion space and a long overhang of the bearing bed. This feature allows ample foot room for the operator. Each bearing is divided into two parts and the large bearing surfaces help to

insure long life. The diameter of the spindle in the bearing is made 1/16 in. oversize, allowing sufficient stock for regrinding when necessary. The portion of the spindle outside the bearings is made sufficiently long to take taper wheels, which have the same width of face as the maximum width of straight wheels. End play on the spindle is easily taken up. The inside flanges are fitted loose on the spindle and driven by a key, making their removal a simple matter. Taper flanges of any make having holes of the right size may be used by cutting a spline in the hole to fit the square key in the spindle.

Oiling is accomplished by the splash system. The oil reservoir, under and between the two parts of the bearing, holds a supply of oil sufficient for several months. All lubricant can be easily and quickly removed, and the reservoir is readily accessible for cleaning. Dust proof covers protect the bearings and an oil guard inside the bearing chamber prevents oil from working out through the joints of the bearing bed and the bearing cover.

The underside of the overhanging bearing bed is provided with



Protection Hood Bracket with Dust Exhaust Connection

a machined seat and tee slots. Work rest brackets, protection hoods and surface grinding attachments are secured by bolts placed in these tee slots, and may be attached or removed very quickly. All attachments are independent and interchangeable. Whenever it is desired to grind large work that requires the removal of the work rest, the work rest bracket can also be removed. This permits the use of a wheel of minimum diameter without interference in grinding large pieces. The top surface of the work rest is chilled, insuring longer life, and is of sufficient size to give adequate support for large and heavy work.

A substantial belt guard, which permits any belt angle from the vertical to 45 deg., extends 2 in. above the top of the maximum size of wheels. This affords protection to the operator, and serves to protect the belt when long pieces are ground on the surface grinding attachment. The protection and dust hood has the double function of providing protection against injury in case of accident to the wheel, and, when connected with a suitable dust removal system, against injury to health from inhala-

tion of dust. The bracket which supports the hood serves also as a dust exhaust pipe.

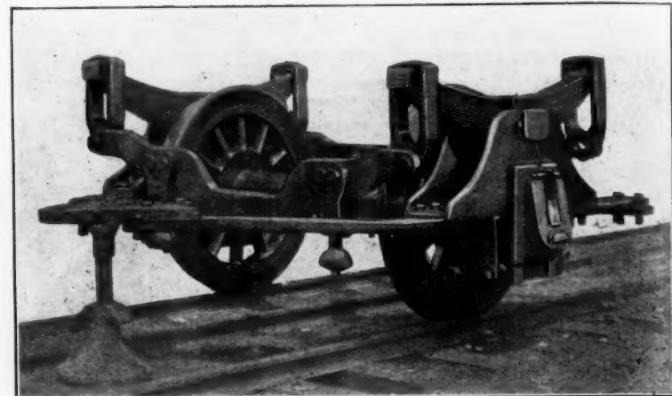
The closed hood consists essentially of a heavy band of boiler plate and two heads or side plates. The hood surrounds about $\frac{5}{6}$ of the wheel, leaving a 60 deg. opening. A heavy steel slide provides adjustment for wheel wear. The slide travels in grooves describing an arc around a center other than the spindle center so that, irrespective of the size of a wheel, 60 deg. of the periphery of the wheel is exposed for grinding purposes and protection is always afforded. This type of hood covers the end of the spindle, thus preventing accidents due to catching clothing in the thread of the spindle. Through the employment of a special lock nut the outer head or side plate is easily removed to permit change of wheels.

AUSTIN TRAILING TRUCK

A gravity centering trailing truck with journal boxes separate from the frame has been brought out by the Lima Locomotive Corporation, Lima, Ohio, and applied to an order of Pacific type locomotives built for the Great Northern. It is designed to simplify the removal and replacement of journal boxes, and to provide a self-centering radial action of sufficient stiffness to prevent undesirable swinging of the rear end of the locomotive.

As shown in the engravings, this truck has separate journal boxes fitting into steel pedestal castings which form part of the frame. To remove the boxes, it is merely necessary to remove the pedestal tie at the bottom of the jaw. The boxes, wheels and axles can then be dropped in the usual manner. The boxes compare with large sized tender boxes in size and weight, and can be handled in much the same manner. Wheels, axles and

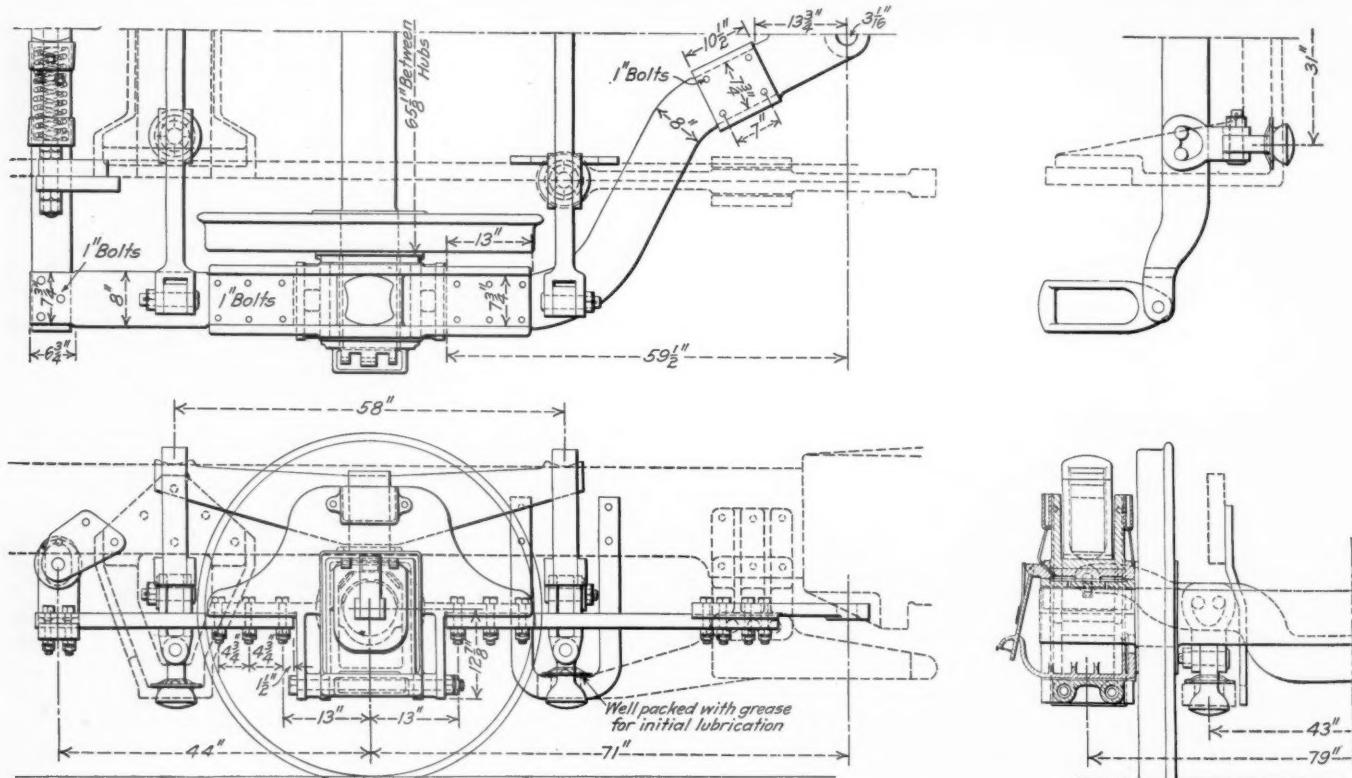
being cast from the same pattern. The radius bar is located approximately on the center line of the axle. This position affords the maximum stiffness to withstand stresses due to horizontal thrust against the axle. It is built up of three parts. The side pieces are of heavy rectangular section, and are securely bolted to a cast steel hinge piece. The rear end of the framing is composed of two side bars secured to the cast steel pedestals, and a cross bar connecting the rear ends of the side bars. On



Austin Trailer Truck Completely Assembled

the cross bar is shown a spring centering device, but this is unnecessary and may be omitted.

The suspension system consists of two transverse cradles, one in front and one back of the axle, which are suspended from the springs by stirrup hangers. The rear cradle receives its load from a fulcrum casting secured to the locomotive frames,



General Arrangement of the Austin Trailer Truck

journal brasses can be made to interchange with those used on other types of trailing trucks.

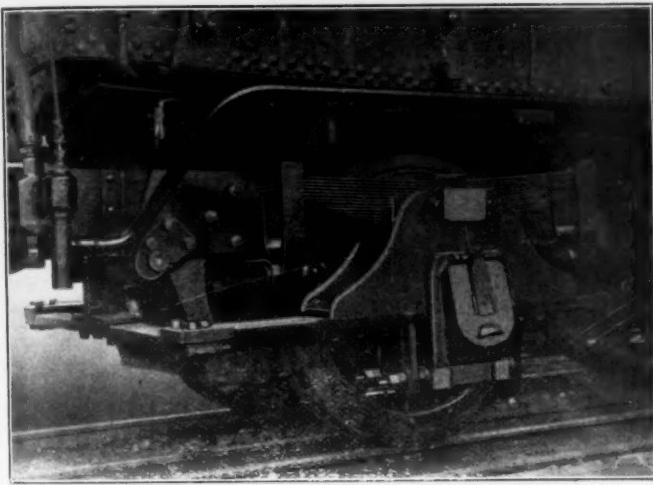
The pedestal castings are rigidly fastened to the radius bar, and in no way depend upon the pedestal ties for stiffness. The sole function of the latter is the retention of the boxes in the jaws. The pedestal castings are reversible, both right and left

and resting on the spherical heads at the lower end of the flexible hangers. The front cradle receives its load from the rear end of the driving equalization system through flexible hangers similar to those on the rear cradle.

The spherical heads at the lower ends of the flexible hangers provide for universal angular movement. The first knuckle

joint above these spherical ends allows a forward and backward movement, which compensates for the longitudinal component of the radial action. The transverse movement of the cradle is governed at the top by the heart-shaped link suspension of the flexible hangers. This suspension gives a rigid bearing and assures stable equilibrium while the engine is on straight track; it always tends to insure recentering on leaving a curve. The suspension system is neither attached to nor guided from the frame at any point except where the load is delivered, thereby eliminating a source of wear and relieving the parts of unnecessary stress.

When the truck acts on a curve there is very little angular stress on any one member of the suspension system. Transverse flexibility is provided for, not only at both ends of the flexible links but at the connection between the cradles and



Austin Trailer Truck in Position Under a Locomotive

spring hangers. These trucks have been observed on twenty-three degree curves and their action is excellent in this particular, the compensating effect of the members of the suspension system being particularly noticeable.

The journal boxes are oiled in the usual manner by packing in the cellars. Oil cellars are located on both the inside and outside frame members, the inner oil cellars serving to oil the wheel hubs, and the outer cellar serving as an auxiliary oiler for the crown brass.

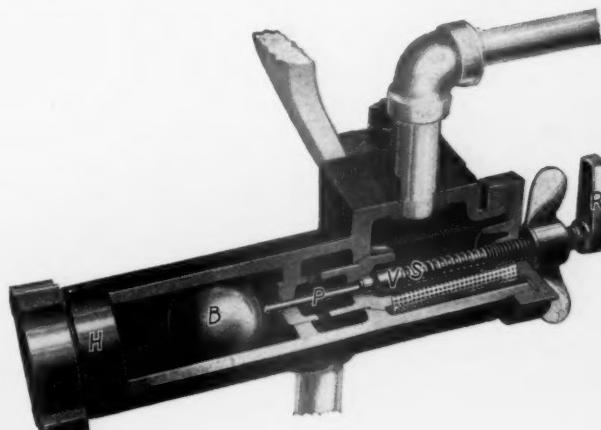
The engine frame construction required by this truck is very simple, the only attachment to the main frames being the fulcrum casting at the rear of the truck.

AUTOMATIC FLANGE LUBRICATOR

A type of flange lubricator for location outside of the cab has recently been brought out, the operation of which is entirely automatic. It consists of an oil tank or reservoir mounted at any convenient location on the running board, a feed nozzle on the flange and between these a ball valve which controls the flow of oil from the reservoir to the flange. This valve is shown in the accompanying illustration. It consists of a body *H* which contains the ball *B* and the plunger *C*, operating the valve *V*. The valve body is installed on road engines with the regulating screw pointing toward the boiler so that any swinging or rolling motion on curves will cause the ball *B* to roll against the plunger *C*, momentarily unseating the ball *B* and permitting oil to flow to the flange. The amount of oil fed to the flange is controlled by the tension of spring *S*. This is regulated by the screw *R* and controls the lift of valve *V*.

On switching locomotives the lubricator body is installed parallel to the center line of the boiler instead of at right angles to it, so that the lubricator is operated by shocks at either end

of the locomotive, such as are caused by a quick stop or by coupling cars. The operation is entirely by gravity, no steam or air connections being required. It is designed to use any kind of oil that will flow freely, and is said to require only suf-



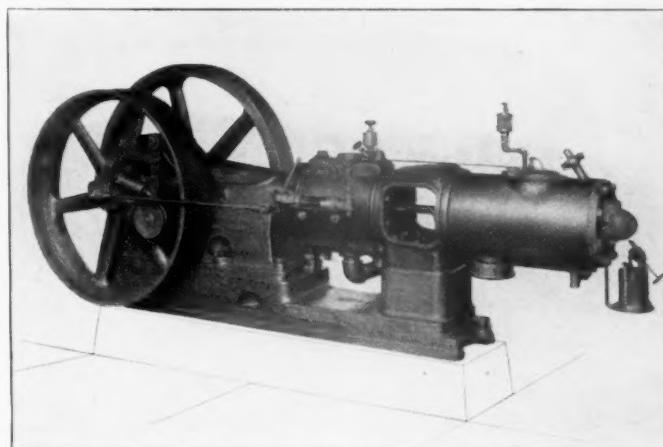
Control Valve of Automatic Flange Lubricator

ficient attention to keep a supply of oil in the tank. It is manufactured by the Detroit Lubricator Company, Detroit, Mich.

DIRECT OIL DRIVEN AIR COMPRESSOR

The increased use of low grade oil fuel for power purposes has led to the design of the oil engine driven air compressor shown in the illustration. This machine, which is built by the Ingersoll-Rand Company, New York, is of the direct-connected straight line type and the design of the air end somewhat resembles this company's standard line of small compressors.

The feature of greatest interest in this machine is the design of the driving end. This consists of a single oil engine cylinder set behind the air cylinder and directly connected,



Direct Driven Air Compressor for Low Grade Oil Fuel

by means of an extended piston rod, to the air piston. It follows, in general design, a type known as the hot bulb engine, which is a development of the Diesel engine, and combines a high thermal efficiency with simplicity of construction.

The power cylinder is of the single acting two-cycle type. It is water-jacketed and is supported by a heavy distance piece, reaching to the foundation and bolted to the air cylinder. It is fitted with a torch for heating the ignition bulb preliminary to starting. After the compressor is under way this torch is dispensed with.

The fuel is automatically injected into the combustion

chamber, by means of a small pump on the side of the frame, operated by the main shaft. It enters in the form of a finely atomized spray and is immediately ignited by the hot bulb, dispensing entirely with electric sparking devices. The stroke of the fuel pump is regulated by a centrifugal governor located in the flywheel, thus regulating the amount of fuel injected into the cylinder in proportion to the load. This is supplemented by a regulating device, on the intake to the air cylinder, of the usual design.

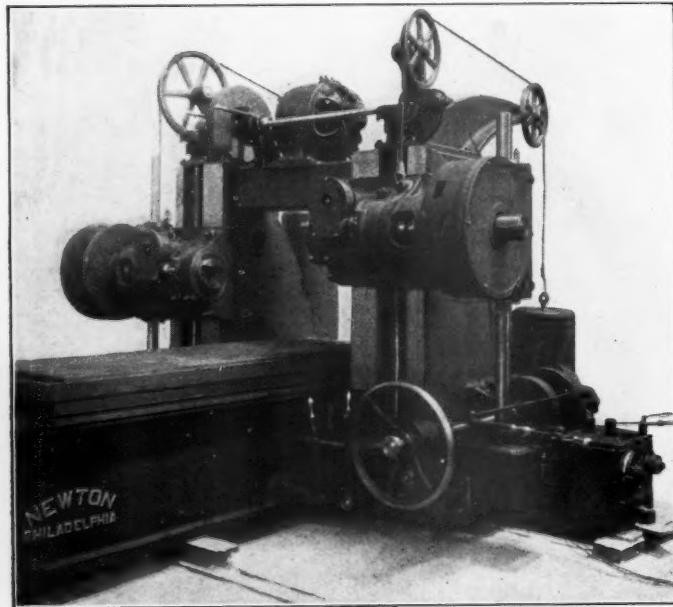
The operation of this machine is free from the losses common to the average two-cycle gasoline engine, in which part of the incoming charge follows the exhaust gases through the outlet ports and is wasted. This is due to the fact that the fuel, instead of being vaporized by an outside agency and introduced with the air used for scavenging, is injected directly into the cylinder, at the end of the compression stroke. Since air only is used during the scavenging period of the stroke, the inlet and outlet ports can be so arranged that more thorough scavenging is afforded.

A small quantity of the water from the cylinder jacket is introduced into the combustion space. This water performs the function of regulating the temperature in the cylinder, thereby preventing an undue rise in temperature of the parts, causing disassociation of the fuel. It tends to reduce the maximum pressure in the cylinder while slightly increasing the mean effective pressure, making a smooth running and highly economical machine. The amount of water injected is regulated according to the load on the compressor.

At present this machine is made in but one size with a capacity when running at 325 r. p. m. of 66 cu. ft. of free air at 100 lb. pressure and 73 cu. ft. at 80 lb. pressure. The fuel consumption at this speed, and under average operating conditions, is claimed to be about 2.2 gal. of kerosene per hour. It is adapted to run on either kerosene, fuel oil or distillate.

HEAVY DUPLEX MILLING MACHINE

Two heavy upright duplex milling machines of the type shown in the illustration were recently furnished to the Pennsylvania Railroad by the Newton Machine Tool Works,



Heavy Upright Duplex Milling Machine

Philadelphia, Pa. This type of machine is adapted to the milling of boxes, shoes, wedges and similar work. When used for slabbing and channeling locomotive rods, an arbor

is placed between the two spindles in order to increase the production by driving the arbor from both ends. The length of the table is 8 ft., the width between uprights is 36 in., and the maximum height from the center of the spindles to the top of the table is 30 in. Each spindle has a maximum in and out adjustment of 10 in.

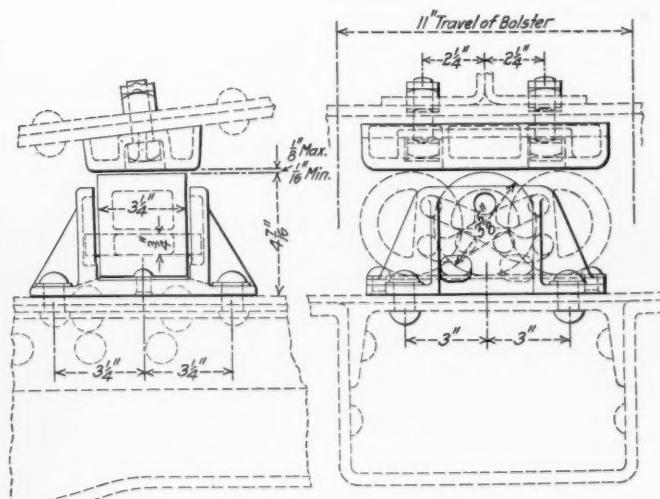
The spindles rotate in bronze bushed sleeves and are arranged to drive by means of broad face keys and to hold the cutters and arbors in place by means of through retaining bolts. Each spindle is driven by a 35 horse power motor, through a large diameter bronze worm wheel and hardened steel worms. The motor speeds range from 500 to 1,500 revolutions per minute. The drive for each spindle is clutched to permit of independent or simultaneous operation, as desired. The spindle saddles are counterweighted and have independent or simultaneous vertical adjustment by hand, control of which is from either side of the machine. In addition to the hand vertical adjustment, reversing power elevation is obtained by means of a 5 horse power motor mounted on top of the tie beam.

Movement of the table is obtained through a coarse pitch steel rack and angular bronze pinion. Nine changes of feed, ranging from $\frac{1}{2}$ in. to 8 in. per minute are obtained without removal of gears, by means of a sliding sleeve feed box. The large hand wheel shown in the illustration is arranged to occupy two positions, one for vertical adjustment of the saddles and the other for adjusting the table. The machine throughout is of very heavy construction, the uprights, the table and the base being heavily ribbed.

FRictionless Return Roller Side BEARING

A side bearing of the single-roller type has recently been developed on the Atlantic Coast Line, and is automatically self-centering without the use of springs or inclined surfaces. It is so designed that the roller will not slide, its movement being rolling whether loaded or light.

The principal difference in construction between this and other types of single roller side bearings lies in the method of securing the roller in the housing. Two pins, one on either end, located off center and approximately 90 deg. apart, project into pockets



Single Roller, Self Centering Side Bearing

in the housing. These pockets are designed to form guides in which the pins move as the roller revolves. The center of gravity of the roller is located off center, thus causing it to return to the central position automatically. The surface on which the roller moves is without incline, and the adjustment

between it and the body side bearings can therefore be made as close as desired.

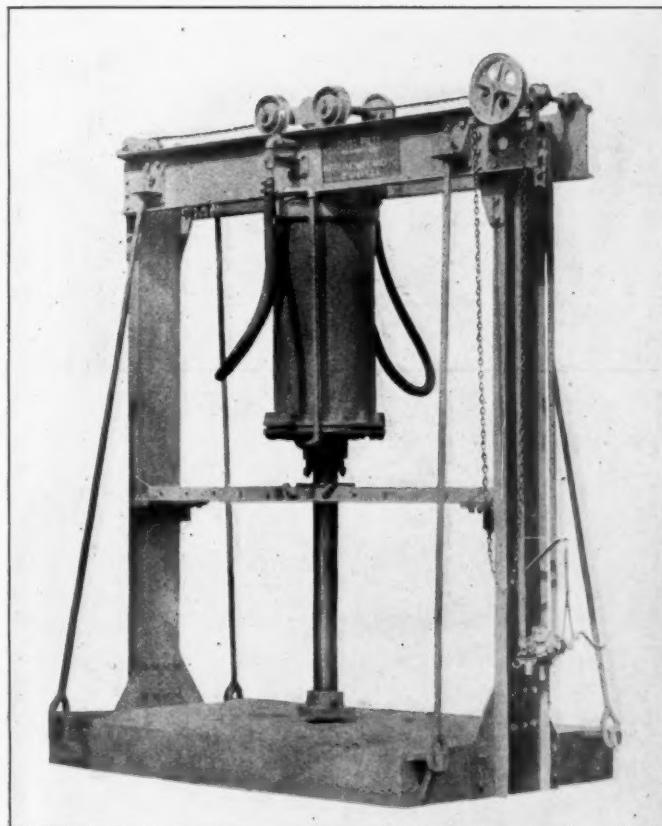
Bearings of this type have been in service on the Atlantic Coast Line for nearly a year and the results are claimed to be very satisfactory. The rollers are amply strong for use under cars of any capacity up to 100 tons. Tests have demonstrated that each roller will stand a load of 55 tons before becoming distorted in any way, and 120 tons without being crushed to destruction.

Application for patent has been filed by C. L. Meister, mechanical engineer of the Atlantic Coast Line. The roller is being manufactured by the National Malleable Castings Company, Cleveland, Ohio.

PNEUMATIC PRESS FOR GENERAL WORK

The 25,000 lb. pneumatic press shown in the accompanying illustrations was developed in the shops of the Central of Georgia at Columbus, Ga. The most important feature of this device is its adaptability to a large variety of bending, straightening and forming operations in connection with the repairing of steel cars, frogs, switches, etc.

A heavy steel table forms the base of the press. Pockets are provided in the table, in which dogs can be placed to keep the work from slipping. The uprights and top cross members are formed of heavy channels. A trolley is provided on the top

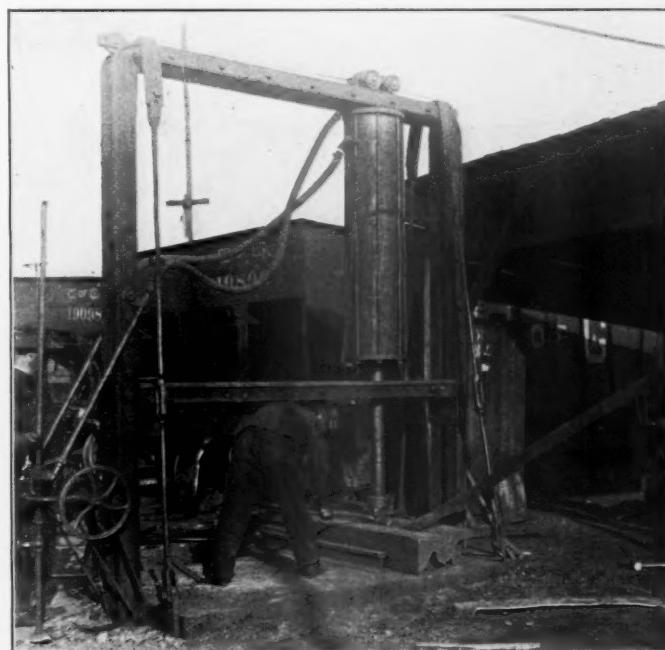


Pneumatic Press Adapted to a Wide Range of Operations

cross members, from which is suspended a 19 in. air cylinder, having a 3 ft. stroke. The cylinder may be moved throughout the entire width of the table by means of a hand chain and gearing on the trolley. The piston rod is 5 in. in diameter and the air cylinder is double acting, so that power can be applied either to push or pull on the rod. The operator's valve is designed to give a very delicate control of the pressure on the piston. The rod is guided by means of a box traveling between two cross channels, which may be securely held at any convenient

point. There are no parts that will be injured by exposure to weather and the press may be installed at any convenient point in the shop yard where compressed air is available.

At the shop of the Central of Georgia, where the original press is still in service, a considerable reduction in the cost of steel car repairs is claimed to have been effected since its installation. The force on this work is stated to have been reduced from 26 to 10 men. Damaged sheets, rolled shapes, sills, etc., from steel cars, truck frames, brake beams and bent drawbars which must be scrapped or put in shape in the blacksmith or boiler shop at considerable expense, can be straightened under the press at a slight cost. With the exception of heavy sills and I beams,



Straightening Steel Car Material with Pneumatic Press

car material is straightened cold and the parts fit, when put together again, without the necessity of reaming rivet holes. The press is very simple and can be operated by common yard laborers without danger of injury to the machine or the operator. It is now being manufactured by the Curtis Pneumatic Machinery Company, St. Louis, Mo.

VERTICAL SHAPER

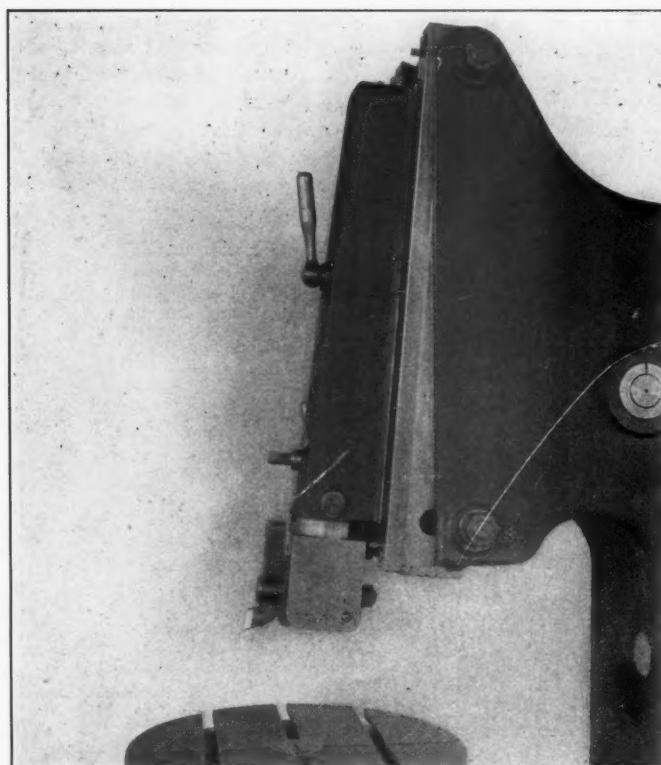
The 10 in. vertical shaper shown in the illustrations has been developed by the Pratt & Whitney Company, Hartford, Conn. It is especially adapted to die cutting, and the tool post construction permits the use of unusually short tools on outside work.

The rotary table is mounted on dove-tailed bearings which are provided with taper gibbs for maintaining the proper relation between the bearing surfaces. Both hand and power control of the longitudinal, transverse and rotary feeds is provided. A quick indexing mechanism also forms part of the construction, whereby the table may be rotated $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$ or $1/12$ of a revolution by disengaging the regular worm hand feed and turning the table by hand.

The ram driving mechanism provides a quick return stroke, and is arranged to afford a convenient method of adjusting the length of the stroke by means of the dial shown on the side of the machine. A clutch, the lever of which is shown in the illustration, provides a means entirely independent of the countershaft for controlling the ram.

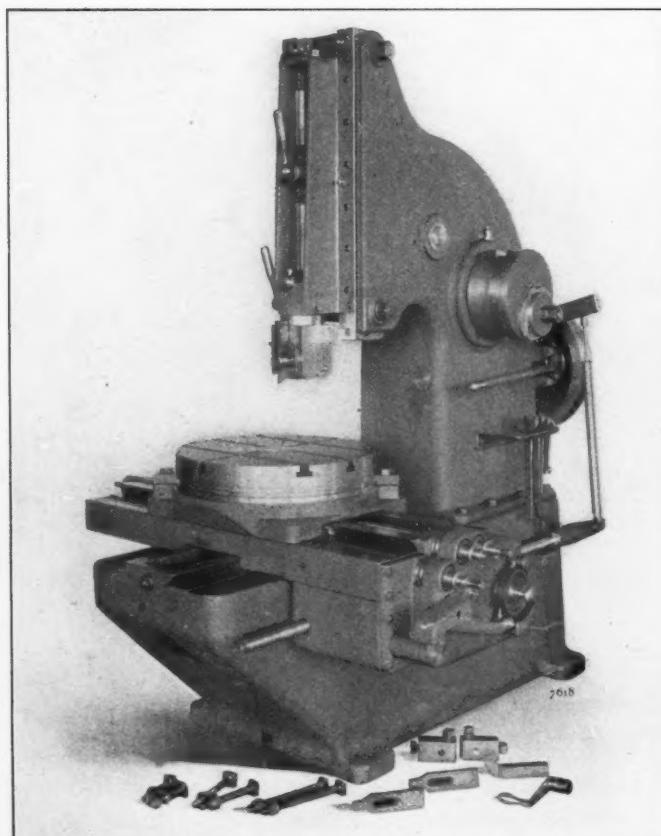
Angular adjustment of the ram is accomplished by mounting it in an independent bearing, the upper part of which is

pivoted on a trunnion, enabling the bearing and the ram to be swung on an angle, suitable graduation in degrees being provided. The ram bearing fits throughout its length in the



Head of Vertical Shaper, Showing Angular Adjustment

upright and is longer than the ram, providing adequate support for the maximum length of stroke.



Ten-Inch Vertical Shaper

A swiveling ram head is provided which enables the operator to adjust the tool in the most advantageous position and permits the planing of two or more sides of the work at one setting. The tool post is designed to clamp from the back, thus eliminating the projection of the clamping screw beyond the cutting edge of the tool. This construction permits the use of short tools on external work.

The angular adjustment to the ram of this machine makes it especially adaptable to the cutting of dies as the ram may be set to give the desired clearance below the cutting edge of the die.

CAR CLOSET

A type of car water closet has recently been developed by the Dayton Manufacturing Company, Dayton, Ohio, which possesses several new features. Before its introduction it was necessary to mount the supply valve at the back of the hopper and below the top. In this position the valve is difficult of access for repairs without disconnecting the pipes and operating connections, and removing the hopper from its fixed position.

In this type of closet the supply valve is mounted on the side wall in an accessible position. It is operated by the customary



Car Water Closet with Separate Supply Valve

lever handle, which is also connected through adjustable rods to the dump pan shaft. The hopper may be set at any angle, and as close to the walls as may be necessary, standard pipe connections leading from the wall valve to the rear of the hopper. The valve is always immediately accessible for renewing gaskets, and it is ordinarily unnecessary to break the pipe connections after the closet is once installed. The closet is adapted for either gravity or air pressure water supply. When air pressure is to be used, a special adjusting valve is furnished.

BRIDGE ACROSS THE HUDSON.—At a highly respectable meeting held at Albany on Wednesday, February 4, a committee of 30 was appointed to draw up a petition to the Legislature on the subject of a bridge across the Hudson.—*From American Railroad Journal, February 14, 1835.*

NEWS DEPARTMENT

Five thousand employees of the Baltimore & Ohio, from points east of Pittsburgh and Parkersburg, will hold their thirty-third annual reunion at Harper's Ferry, W. Va., on July 30.

Two men, who recently held up an Illinois Central passenger train in Louisiana, have been indicted at Amite City, La., for murder. The negro porter on the train was shot by the robbers and died soon afterward.

At the Anglo-American Hundred Years Peace Exposition, now open in London, the Southern Railway has the only exhibit made by an American railway. It is a handsome display of the agricultural, horticultural and mineral products of the southern states.

By the new time tables adopted recently, the New York, New Haven & Hartford discontinues 163 passenger trains, making a saving of 3,350 train miles a day. It is said that these trains have been found to be earning less than 50 cents a mile. The Philadelphia & Reading has discontinued a number of short-trip passenger trains.

The Union Pacific is to show at the Panama-Pacific International Exposition at San Francisco, next year, a reproduction of the notable features of Yellowstone National Park, and it has been estimated that the cost of the display will be \$500,000. This display will occupy four acres of ground near the eastern entrance to the exposition enclosure.

On the Pennsylvania Railroad, by a recent order, whenever passenger coaches are crowded, a train man must announce the number of seats available in other coaches, and must tell the number of seats available in each coach. Special care must be exercised at the larger terminals where passengers are liable to be inconvenienced by the congestion of travel.

The Erie Railroad, when sued recently by a milkman for \$25,000 damages on account of an injury received when he drove his horse and wagon on a highway crossing, and was struck by a locomotive, replied with a counter claim of \$100 for damage to the locomotive, declaring that the plaintiff had approached the crossing at a rapid, reckless and dangerous rate of speed.

Eleven thousand Italians are employed on the Pennsylvania Railroad, and the company has issued a leaflet telling something of their activities. These men are not all laborers, a list being given showing twenty-five or more different occupations, in which they are engaged. On the Pittsburgh division there are twenty-seven Italian track foremen and 42 assistant foremen. More than 2,000 Italian employees of the road are studying English in a correspondence course, maintained by the company for their benefit.

Dr. Harold Pender, professor of electrical engineering at Massachusetts Institute of Technology, and director of the research division of the department of electrical engineering, has been appointed professor-in-charge of the department of electrical engineering at the University of Pennsylvania, to take the place next fall. Heretofore the departments of mechanical and electrical engineering at the University of Pennsylvania have been under the joint direction of the Whitney professor of dynamical engineering. From the beginning of next year the department of electrical engineering will be on an independent and co-ordinate footing with the departments of civil and mechanical engineering.

The musolophone is being installed in the new terminal station of the Canadian Pacific at Windsor street, Montreal. The "muso-

lophone" is a telephone with a large receiver used to announce trains in the waiting rooms and other parts of the station, a single announcer talking into a telephone transmitter which is connected with as many receiving instruments as may be desired. It appears that devices of this kind, of three or more different makes, are now in experimental use in one or more cities. The device in the Grand Central Terminal, New York City, which was installed there two or three years ago, is now used only in the smaller rooms, the large central waiting room having developed such loud and troublesome echoes that the use of the telephone arrangement was given up.

On June 13 and 16 the Long Island Railroad carried more than 50,000 people between New York and the polo grounds at Meadow Brook, Long Island, all without accident to either passengers or employees. About 15,000 passengers were taken to Manhattan and Brooklyn after Tuesday's game was over. Saturday, the 13th, was one of the biggest days the Long Island Railroad has ever had, in that it carried, on all its lines, about 300,000 passengers, 23,000 of whom were passengers to and from the first polo game. Twenty-four trains were unloaded at Meadow Brook on Tuesday in little more than an hour; and all this business was handled on a single track branch line which ordinarily is but little used for traffic. The Pennsylvania station, New York, which is the Long Island terminal in Manhattan, received and despatched more trains in the four days ending Tuesday midnight than during any similar period since the station was opened to the public. In these four days over 1,600 trains were handled there, and it is estimated that 750,000 people availed themselves of the facilities of the station, while the number of passengers arriving and departing was over 570,000, an average of more than 142,000 per day. The largest number using the station in any one day was on Saturday, approximately 170,000. All of the additional traffic was handled without any delay to the regular trains.

A CORRECTION

G. E. Sisco, assistant engineer of motive power of the Pennsylvania Lines West, advises that the statement made in his discussion of the paper on Front End Design and Air Openings of Grates and Ash Pans, before the International Railway Fuel Association and reported in the Railway Age Gazette, Mechanical Edition, June, 1914, page 285, giving the evaporation per hour for the locomotive with elliptical nozzle as 58,882 lb., should have been 53,882 lb.

NEW RAILROAD Y. M. C. A. BUILDING IN NEW YORK

The railroad branch of the Young Men's Christian Association of New York City, which is the title of the well-known institution on Madison avenue near the Grand Central Terminal, has moved into a new building which has been built on the east side of Park avenue, between Forty-ninth and Fiftieth streets. The building which has been occupied for the past 25 years is to be torn down to make way for extensions of the Grand Central Terminal. The new building stands on steel columns above the tracks of the yard, about 1,000 ft., or four blocks, north of the northerly front of the station. It is 200 ft. long, 47 ft. deep and seven stories high, of cream colored pressed brick trimmed with Indiana limestone. On the right of the main entrance hall is a social room 40 ft. x 70 ft., adjoining which is a reading and writing room. This floor, in addition to the usual facilities, has a barber shop and a billiard room.

On the second floor is a restaurant having three dining

rooms, with a total seating capacity of 320. The association intends to run a model dining room and kitchen, both to be open at all times to visitors. Prices of meals will range from ten cents to fifty cents, the popular luncheon being 30 cents, table d'hôte. The kitchen is 130 ft. by 27 ft., and adjacent to it are a rest room and a dressing room for the waitresses. The third floor has a gymnasium 40 ft. by 75 ft., two full stories in height, with a spectators' gallery. This room has a stage and a dressing room, and when used as an auditorium will seat 500 persons. On this floor there are bowling alleys and class rooms for night schools; also the association library and a dark room for the Camera club. On the fourth floor there is a lecture room, seating 125 persons; and the balance of this floor, together with the fifth, sixth and seventh stories will be used entirely for dormitories, having a sleeping capacity for 226 men. The sleeping rooms average 6 ft. by 17 ft., and all have outside windows. On the roof there are tennis and hand ball courts.

This association was started in October, 1875, and Cornelius Vanderbilt, grandson of Commodore Vanderbilt, was its most liberal patron. He gave the building which has now been abandoned, the railroad company furnishing the land. For the new building at Forty-ninth street William K., Frederick W. and Alfred G. Vanderbilt have given \$100,000 each, and the two railroad companies have given large sums. The right to the site is held by a long lease.

THE UNIVERSITY OF PITTSBURG RAILWAY MECHANICAL ENGINEERING COURSE

The school of engineering of the University of Pittsburgh is going to offer, beginning with the fall of this year, a comprehensive course in railway mechanical engineering and administration in which instruction will be given in such subjects as materials of railway engineering, operating units, railway design, utilization of locomotives and cars, railway shop methods, fundamentals of railway practice, etc. L. E. Endsley, now connected with the railway course at Purdue University, has been made a professor in the new course with the title of professor of mechanical railway engineering. Mr. Endsley is at present professor of railway mechanical engineering at Purdue, and has been with that school since his graduation from it in 1901. In 1903, he was appointed instructor in the locomotive laboratories of the university. He was advanced two years later to assistant professor, and in the following year became associate professor of railway mechanical engineering. In 1908 he was appointed professor of railway mechanical engineering and was given direct charge of the Master Car Builders' laboratory, which is located at Purdue University. In that way he has had charge of the tests conducted on the brake shoe testing machine of the Master Car Builders' Association for the last 12 years. He has also conducted a great many tests pertaining to superheated steam, and has presented papers relating to that work before the Master Mechanics' Association. Mr. Endsley was in direct charge of the locomotive laboratories during the tests on locomotive front ends, conducted by the Master Mechanics' Association. He also conducted, some years ago, for the American Steel Foundries



Copyright by Moffett, Chicago.
L. E. Endsley

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some interesting tests on the construction of the freight car truck as affected by the different degrees of curvature. The new department in which Mr. Endsley has become a professor, is under the direction of D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West of Pittsburgh.

ELECTRICAL ENGINEERING RESEARCH AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The activities in electrical engineering research at the Massachusetts Institute of Technology have developed very rapidly during the past year and a noteworthy extension of the organization for administering the researches has recently been effected. This has been aided by the co-operative agreement between Harvard University and the Institute of Technology whereby the departments of electrical engineering in the two institutions were practically merged.

By this new organization for the research laboratory there is created a research committee, to whom reports are made upon the progress of the various researches. The committee comprises the following members of the electrical engineering department staff: those who are supervising or actively engaged in research work in the research laboratory; those who are personally carrying on research work in any branch of the department; and those who have completed a reorganized piece of research work during the preceding year. The research committee, as a whole, will meet once a month during the school term, such meetings being open to all members of the department staff. The chairman of the research committee is also chairman of the executive committee of three members, who will carry on the executive work of the general committee. By this arrangement the research activities of the department will be brought into close relation with the regular teaching work. Thus, any member of the staff, whether professor, instructor, or assistant, who desires to carry out any original investigation may become identified with the research work through the research committee. Some of the special resources of the research laboratory which have not been designated for use in a particular investigation may be used in providing such a man with apparatus and other laboratory facilities. Even if a member of the department staff is not able to devote a considerable portion of his time to an experimental investigation, he still has the opportunity of offering suggestions upon the conduct of investigations which are being made by others. From the standpoint of the younger members of the staff, the opportunities of entering the enthusiastic atmosphere which accompanies the successful conduct of original research are most unusual.

The staff of the research laboratory at present includes six research associates and assistants who give their whole time to research. This number will be increased to nine on July 1, 1914. In addition to the work of these men, who are appointed by the institute, the theses of four students who are candidates for advanced degrees in electrical engineering have been carried on in the research laboratory during the past year. The study of a wide variety of problems has already been undertaken by the laboratory.

MEETINGS AND CONVENTIONS

International Railway Fuel Association.—It is announced that the seventh annual convention of the International Railway Fuel Association will be held at Chicago, May 17-20, 1915.

Air Brake Association.—The executive committee of the Air Brake Association has decided that the twenty-second annual convention of the association will be held May 5-7, 1915, at the Hotel Sherman, Chicago.

International Railway General Foremen's Association.—Wm. Hall, secretary-treasurer of the International Railway General Foremen's Association, has moved his office from 829 to 914 West Broadway, Winona, Minn.

Seventh Congress of the International Association for Testing Materials.—The seventh congress of the International Association for Testing Materials will be held under the patronage of the Czar of Russia, in St. Petersburg, August 12-17, 1915. Four days will be devoted to the discussion of the most important problems on testing materials. After the congress extensive excursions in the interior of Russia have been arranged.

American Railway Tool Foremen's Association.—The sixth annual convention will be held in Chicago, July 20-22, at the Hotel Sherman. The following is the program: July 20, 9:30 a. m.—Opening address; Standardization of Reamers for Locomotive Repairs; Machine Tool Repairs.

July 21.—Special Tools for Drilling, Reaming and Milling; Tool Room Grinding; address: Safety First in Grinding.

July 22.—Distribution of Tools for Shop Use; Dies for Cold Work, Press and Special Punching.

Chief Interchange Car Inspectors' and Car Foremen's Association.—The annual convention of this association will be held in the Hotel Sinton, Cincinnati, Ohio, August 25-27. The prospects are that it will be one of the largest and most important meetings in the history of the association, and every one who can possibly attend is urged to do so. It is being recognized by car department officers that the interpretation given to the M. C. B. rules of interchange at the meetings of this association are of great help to all those concerned in the interchange of cars.

International Railway General Foremen's Association.—The outlook for a good convention this year is very bright; assurances are being received from many members of their intention to attend, and they are being encouraged by their superintendents of motive power not only to attend the convention, but also to become members of the association. Advance copies of the various papers were sent out to all the members 30 days prior to the convention, and all concerned should read these papers over carefully. It is expected that a new departure will be made at this convention, in that the topics will be announced from the chair, and the members will proceed at once with the discussion, thus dispensing with the lost motion of reading the paper through first, so that unless the papers have been read before they are taken up in the convention, they cannot be discussed intelligently.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-7, 1915, Hotel Sherman, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Karpen building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga. Convention, July 20-22, 1914, Hotel Sherman, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lyton building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Convention, August 25-27, 1914, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 914 W. Broadway, Winona, Minn. Convention, July 14-17, 1914, Hotel Sherman, Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 8-11, 1914, Nashville, Tenn.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September 15, 16, 17 and 18, 1914, Hotel Sherman, Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

C. O. DESTICHE has been appointed superintendent of motive power of the South Dakota Central, with office at Sioux Falls, S. D., succeeding H. J. Osborne, resigned.

A. C. HINCKLEY, superintendent of motive power and machinery of the Oregon Short Line, has moved his office from Salt Lake City, Utah, to Pocatello, Idaho.

WILLIAM T. KUHN has been appointed superintendent of motive power of the Toronto, Hamilton & Buffalo, with office at Hamilton, Ont. Mr. Kuhn was born in 1872 at East Radford, Va. He was educated at the Radford high school and took the complete mechanical course in the Scranton Correspondence School. He began railroad work in 1888 on the Norfolk & Western as an apprentice machinist. In the following two years he worked as machinist, roundhouse foreman and assistant air brake instructor. In 1900 he went to the Lake Shore & Michigan Southern as roundhouse foreman, and later was made mechanical inspector, with duties which included the inspection of new locomotives. In March, 1911, he was appointed assistant master mechanic of the Lake Erie & Western, and in October of the same year went to the Toronto, Hamilton & Buffalo as master mechanic, which position he held until his present appointment.

HARVEY SHOEMAKER has been appointed mechanical superintendent of the Bangor & Aroostook, with office at Derby, Me., succeeding R. Q. Prendergast, resigned. Mr. Shoemaker began railroad work in 1886 on the Lehigh Valley at Wilkesbarre, Pa., as a machinist. Before 1901 he had been made gang foreman and then general foreman of this shop. In 1901 he was appointed general foreman of the locomotive department of the Delaware, Lackawanna & Western, in charge of the Scranton shops. In 1903 he was made master mechanic of the Scranton division, holding this position until May, 1911, when he went to the New York, Ontario & Western in charge of shop construction work at Middletown, N. Y. After the shops at that place had been completed, he was made shop superintendent, which position he held until June 1, 1914.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

DAVID GRATTON has been appointed master mechanic of the Oregon Short Line at Pocatello, Idaho.

A. GUILD has been appointed master mechanic of the Hawaii Railway at Makukona, Hawaii.

R. E. HAMMOND has been appointed acting road foreman of engines of the Northern Pacific at Minneapolis, Minn., in place of John Horan.

J. M. O. HOLLMAN has been appointed master mechanic of the North Louisiana & Gulf at Hodge, La.

JOHN HORAN, road foreman of engines of the Northern Pacific at Minneapolis, Minn., has been appointed acting master mechanic at that point, succeeding J. B. Neish.

D. J. MALONE, master mechanic of the Oregon Short Line at Ogden, Utah, has been transferred to Pocatello, Idaho.

J. B. NEISH, master mechanic of the Northern Pacific at Minneapolis, Minn., has been granted leave of absence.

J. C. SCHEPP, general foreman of shops of the Texas & Pacific at Marshall, Tex., has been appointed master mechanic at Texarkana, Tex., succeeding George M. Lovett.

F. STONE has been appointed road foreman of engines of the Chicago & Alton at Slater, Mo.

CAR DEPARTMENT

J. M. HAWKINS has been appointed car foreman of the Chicago, Rock Island & Pacific at Eldon, Mo., succeeding G. N. Dorr, transferred.

N. B. JONES has been appointed car foreman of the Canadian Pacific at Kenora, Ont., succeeding H. K. York, transferred.

B. F. ORR has been appointed division car foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, Ind.

H. K. YORK, formerly car foreman of the Canadian Pacific at Kenora, Ont., has been appointed car foreman at North Transcona, Man.

SHOP AND ENGINE HOUSE

J. A. CARLESTON has been appointed general foreman of the Texas & Pacific at Marshall, Tex., succeeding J. C. Schupp, promoted.

D. D. COSSAR, night locomotive foreman of the Canadian Pacific at Moose Jaw, Sask., has been appointed locomotive foreman at North Transcona, Man.

B. E. GREENWOOD has been appointed foreman of the power house of the Norfolk & Western at Bluefield, W. Va.

W. F. HEINBACH has been appointed engine house foreman of the Philadelphia & Reading, at East Penn Junction, Pa.

F. JOHNSON has been appointed night locomotive foreman of the Canadian Pacific, at North Transcona, Man.

E. MARSHALL, formerly general foreman of the Canadian Pacific at McAdam Jct., N. B., has been appointed locomotive foreman at Bay Shore, N. B.

A. J. PENTLAND, formerly night locomotive foreman of the Canadian Pacific at Swift Current, Sask., has been appointed locomotive foreman at Ignace, Ont., succeeding H. J. Reed, transferred.

G. T. SCHROEDER has been appointed day roundhouse foreman of the Chicago, Rock Island & Pacific at Manly, Iowa, succeeding N. J. Lawson, resigned.

A. STURROCK, formerly erecting shop foreman of the Canadian Pacific at Vancouver, B. C., has been appointed general foreman at Ogden Shops, Calgary, Alta.

W. WELLS has been appointed general foreman of the Canadian Pacific at McAdam Jct., N. B., succeeding E. Marshall, transferred.

F. L. WILLIS, formerly assistant locomotive foreman, has been appointed locomotive foreman of the Canadian Pacific at McAdam Jct., N. B.

W. WORTMAN, gang foreman of the Canadian Pacific, at Winnipeg, Man., has been appointed erecting shop foreman at Vancouver, B. C., succeeding A. Sturrock, promoted.

PURCHASING AND STOREKEEPING

ERNEST BAXTER has been appointed purchasing agent of the St. Louis Southwestern, with headquarters at St. Louis, Mo., succeeding J. E. Sargeant.

H. B. MARTIN has been appointed purchasing agent of the Coal & Coke Railway, with office at Elkins, W. Va.

OBITUARY

WALTER J. EDDINGTON, general foreman of the Atchison, Topeka & Santa Fe at Corwith, Ill., died at his home in Chicago on May 29, aged 65 years.

D. C. CHENEY, fuel inspector of the Chicago, Milwaukee & St. Paul, died at his home in Chicago on May 29, aged 60 years. He had been connected with the St. Paul since 1873, beginning as a telegraph operator and filling successively the positions of assistant train despatcher, chief despatcher, trainsmaster, division superintendent, and general superintendent of the Middle district, until 1910, when he was appointed fuel inspector.

Alexander Stewart, general superintendent of motive power and equipment of the Southern Railway, with office at Washington, D. C., died suddenly at the Hotel Continental in Paris, France, on June 28. Mr. Stewart had been in bad health for several months and, on June 16 accompanied by his wife and only daughter, sailed on the *Mauretania* for Bad Nauheim, Germany, where it was hoped he would fully regain his health. Mr. Stewart was 46 years old and widely known in the railroad world as one of the most capable and experienced men of his profession. He was born at Fort Wayne, Ind., and began at an early age to prepare for the railroad business. He entered the service of the Union Pacific as



A. Stewart

machinist's apprentice, and after serving his apprenticeship, worked consecutively as machinist, foreman, general foreman, general division foreman and then as master mechanic at Cheyenne, Wyo. In 1903 he left the service of the Union Pacific to go to the Southern Railway as division master mechanic at Knoxville, Tenn. A little later he was promoted to general master mechanic of the Western district, and on April 1, 1904, he was appointed mechanical superintendent of the same road. Two years later he was promoted to general superintendent of motive power and equipment, with headquarters at Washington, D. C., and also chairman of the Committee on Mechanical Standards of the Southern Railway and the following affiliated lines: Alabama Great Southern; Cincinnati, New Orleans & Texas Pacific; Mobile & Ohio and Georgia Southern & Florida railroads, which positions he held at the time of his death. In 1910 he attended the International Railway Congress at Berne, Switzerland, as a delegate, and in 1911 was elected president of the Master Car Builders' Association; he was also a member of the Master Mechanics' Association. There was no man who was held in higher esteem than Mr. Stewart by his associates, as well as those who served under him, and he was widely known in fraternal and club circles.

RAILWAY EXTENSION IN THE PHILIPPINES.—The Manila Railway has altogether about 10,000 men at work on the various extensions of its line now in course of construction. Included in the list of projects which are under way are: a branch to Baguico; a branch from San Francisco to Arayat; a branch from Panique to Rosales, San Quintin and Tayug and a division from Albay to Neuva Caceres. The branch from Panique to Rosales is complete to about eight miles from San Quintin. North of Aringay, the track extension is delayed at the Naguillian river, eight miles south of San Fernando where a bridge of 11 spans, 150 ft. each in length, is being built. This will be the largest bridge in the Philippines. It is also hoped to open a branch from Lucena towards Laguiminoc in July.

SUPPLY TRADE NOTES

Dudley A. Johnson has been appointed branch manager of the Chicago office of the Joseph Dixon Crucible Company, succeeding the late Sam Mayer.

The American Hoist & Derrick Company, St. Paul, Minn., has moved its Seattle office from 613 Western avenue to 1512 L. C. Smith building.

W. D. Jenkins, 1408 Whitney Central building, New Orleans, La., has been appointed southern representative of the Union Railway Equipment Company, Chicago.

H. W. Green, for the past ten years district sales agent for the American Steel Foundries in Pittsburgh, has been elected vice-president of the Lawrence Steel Casting Company, Pittsburgh, Pa.

James M. Swank, at one time editor of Iron Age and formerly vice-president and general manager of the American Iron & Steel Association, died at his home in Philadelphia on June 22.

C. H. McCormick, formerly district manager of the Standard Heat & Ventilation Company at Cincinnati, Ohio, has been promoted to the position of vice-president, with office at 1949 Peoples Gas building, Chicago.

Charles Neilson, formerly general manager of the Cincinnati, Hamilton & Dayton, and before that superintendent on the Erie, has opened an office as consulting engineer at Room 1642, 30 Broad street, New York City.

The Taylor-Wharton Iron & Steel Company, High Bridge, N. J.; Wm. Wharton, Jr., & Company, Inc., Philadelphia, Pa., and the Tioga Steel & Iron Company, Philadelphia, Pa., have removed their Seattle office to 1604 L. C. Smith building.

L. R. Pomeroy, the well known railway and electrical engineer, has been appointed manager of the New York sales office of the United States Light & Heating Company, of Niagara Falls, with office at 24 West Sixty-first street. Mr. Pomeroy has been in the railroad and railroad supply business for more than thirty-five years, and has a very wide acquaintance. He was born at Port Byron, N. Y., in 1857, and was educated at Irving Institute, Tarrytown, N. Y. From 1880 to 1886 he was secretary and treasurer of the Suburban Rapid Transit Company, of New York, and then for nine years he was with the Carnegie Steel Company, introducing basic boiler steel for locomotives and special forgings. Subsequently he engaged in the same kind of work with the Cambria Steel Company and the Latrobe Steel Company jointly. For three years to 1902 he was assistant general manager of the Schenectady Locomotive Works, and then for six years represented in the railway field the General Electric Company. He then went to the Safety Car Heating & Lighting Company, and afterwards to J. G. White & Co. as chief engineer of the railway and industrial divisions. For some time past he has been engaged as a consulting engineer.



L. R. Pomeroy

The second-hand locomotive, car and railway equipment business of the late J. T. Gardner will be continued under the name of James T. Gardner, Inc., with M. Gardner, president; R. H. Gardner, vice-president; A. V. Talbot, secretary and general manager, and A. M. Talbot, treasurer. Offices in the Railway Exchange, Chicago.

H. P. Webb, St. Louis, Mo., has been appointed railway sales agent for the St. Louis territory by the Union Fibre Company of Winona, Minn. During the last few years Mr. Webb has been in the railway supply business at St. Louis, and previous to that time he was connected with the purchasing departments of several of the St. Louis railroads.

The Titanium Alloy Manufacturing Company, Niagara Falls, N. Y., has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. Wm. M. Corse, formerly works manager of the Lumen Bearing Company, Buffalo, and lately general manager of the Empire Smelting Company, Depew, N. Y., will be made manager of the new department.

The Niles-Bement-Pond Company was awarded the first prize of \$20,000 in the contest announced last year by the Chilean Government for the best design for a general railroad shop. The awards were made the first week in June, the second prize of \$10,000 going to a combination Belgian and English concern. It is expected that the shops will cost \$3,000,000.

E. P. Dillon and M. B. Lambert, both of whom have been connected with the railway and lighting department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for a number of years, have been appointed to the new positions of assistant managers of the railway and lighting department. Mr. Dillon will have charge of the commercial activities of the company in connection with the generation and distribution of power involving power house substations, transformer stations and similar apparatus. Mr. Lambert will have charge of all sales work pertaining to electric traction, including steam, interurban and city railroads.

NEW SHOPS

ATCHISON, TOPEKA & SANTA FE.—This company has authorized the construction of a reinforced concrete engine house, crane runway, radial tracks and turntable, at Albuquerque, N. M., at an approximate cost of \$100,000.

SAVANNAH & STATESBORO.—This road has just completed a one story 66 ft. x 72 ft. repair shop at Statesboro, Ga.

THE LOUISVILLE AND PORTLAND CANAL.—The number of steam-boats which passed through the Louisville and Portland Canal during the year 1834, was 938; the number of keel and flat boats 623; the total tonnage was 162,000 tons, and the amount of tolls received thereon \$61,848.17.—*From the American Railroad Journal, February 14, 1835.*

CAMDEN AND AMBOY RAILROAD.—This afternoon the following resolution was called up in the Council on its final passage, and carried by a vote of 11 to 2: "Resolved, That the passage of any act by the Legislature, authorizing or recognizing any other railroad across this state, which shall be intended or used for the transportation of passengers or merchandise between Philadelphia and New York, would be unjust, impolitic, in violation of the faith of the state, and deeply injurious to its interests."—*Extract from a letter dated Trenton, February 17, 1835, in the American Railroad Journal, February 28, 1835.*

CATALOGS

ROPE DRIVES.—The Mesta Machine Company, Pittsburgh, Pa., has issued bulletin O dealing with that company's rope drive system for power transmission. The bulletin contains eight pages and includes a number of illustrations of typical installations.

AIR HOISTS.—Catalog No. 107, superseding No. 93, from the Whiting Foundry Equipment Company, Harvey, Ill., deals with the subject of air hoists. A number of illustrations are included as well as a table of sizes. This catalog will be sent free on request.

HAND TRAVELING CRANES.—Catalog P from the Brown Hoisting Machinery Company, Cleveland, Ohio, contains 36 pages and is devoted to the hand traveling cranes built by this company. The booklet is completely illustrated and contains price lists and other data.

CAR DOOR FASTENERS.—The Universal Car Seal & Appliance Company, Albany, N. Y., has issued a leaflet dealing with the Universal car door fastener. The leaflet includes illustrations which show very clearly the construction and application of this fastener to a car door.

WAGON AND TRUCK LOADERS.—This is the subject of book No. 190 issued by the Link Belt Company, Chicago. The book contains 32 pages and illustrates and describes a variety of loaders working on the link belt principle and used for loading loose material from ground storage.

BRAKE BEAMS.—A 28-page catalog recently received from the Buffalo Brake Beam Company, 30 Pine street, New York, is devoted to the brake beams and brake beam details manufactured by this company. The catalog is well illustrated and contains dimension drawings of a number of the beams.

PRESSED STEEL TRUCKS.—A ten-page folder recently issued by the Pressed Steel Truck Company, Pittsburgh, Pa., deals with the Atlas indestructible pressed steel hand truck. This is a two-wheel hand truck with special construction features and is made in a number of different sizes to suit various classes of work.

MILLING MACHINES.—Catalog No. 48, issued by the Newton Machine Tool Works, Philadelphia, Pa., is devoted to the subject of milling machines. This catalog is a book of 48 pages and thoroughly illustrates the various types of milling machines manufactured by this company. Descriptive matter is also included.

AIR COMPRESSORS.—Bulletin N from the Mesta Machine Company, Pittsburgh, Pa., deals with the air compressors and vacuum pumps manufactured by this company. The illustrations include reproductions of indicator cards taken from air compressors and also from cards taken from vacuum pumps equipped with Mesta plate valves.

DRINKING WATER FOUNTAINS.—A four-page leaflet issued by the Manufacturing Equipment & Engineering Company, Boston, Mass., includes illustrations and descriptive matter dealing with sanitary bubbling fountains. This company also manufactures individual sanitary wash bowls and reference is made to these in the leaflet.

FORGING MACHINES.—The National Machinery Company, Tiffin, Ohio, has recently issued National Forging Machine Talk No. 2, which is a folder dealing with the bed frame as a potent factor in the efficiency of the forging machine. Illustrations are included showing the steel bed frame casting for National heavy-pattern forging machines.

BRASS FOUNDRY EQUIPMENT.—Bulletin No. 31, from J. W. Paxson Company, 1021 North Delaware avenue, Philadelphia, is a 54-page booklet dealing with the brass foundry equipment furnished by that company. This includes furnaces, flasks, tongs, grinding and washing machines, etc., as well as a complete line of smaller equipment for brass foundry use.

ELECTRIC LIGHTING FIXTURES.—Bulletin No. 173 from the Dayton Manufacturing Company, Dayton, Ohio, deals with large unit lighting fixtures for electric railway cars. A number of different types are considered, including ceiling pendants, side brackets and ceiling fixtures, and considerable space is devoted to illustrating and describing the Flex shade holder.

MACHINE GUARDS.—A 34-page booklet issued by the Consolidated Expanded Metal Companies, Pittsburgh, Pa., is devoted almost entirely to the expanded metal guards for gear wheels and belts manufactured by these companies for preventing accidents on machine tools. The booklet contains very clear illustrations showing these guards applied to machines.

SAFETY SWITCH PANEL.—Bulletin No. 34 from H. Krantz Manufacturing Company, Brooklyn, N. Y., considers the safety panel manufactured by this company. Among the features claimed for this panel are that no live parts are exposed and all parts subject to wear are removable from the front of the board and can be replaced without adjustment. Illustrations and data for the different sizes and types are included.

CASE HARDENING WITH GAS.—A 26-page booklet issued by the American Gas Furnace Company, 24 John street, New York, describes an improvement in mechanical heating processes for case hardening work. It is claimed that by this process the surface of wrought iron or steel of low carbon may be converted into high carbon steel to any practical depth required for case hardening, at the same time leaving a core soft.

GEARED SCREW JACKS.—A catalog issued by the Cayuta Manufacturing Company, Thayer, Pa., illustrates and describes the standard ball and cone bearing geared screw jacks manufactured by this company. The catalog contains 24 pages and is well illustrated, among the jacks included being a high speed motor driven ball bearing screw jack. This jack is intended especially for quick work and is operated by an air motor.

INDUSTRIAL AND CONTRACTORS' LOCOMOTIVES.—Record No. 78 of the Baldwin Locomotive Works, Philadelphia, is devoted to the subject of locomotives for industrial and contractors' service. The locomotives included in this booklet vary from four wheel tank engines weighing 28,500 lb. to a Mikado with a total weight of 207,000 lb. Half tone illustrations are given and the leading dimensions of each locomotive are printed under the illustrations.

THERMIT IN RAILROAD SHOPS.—The Goldschmidt Thermit Company, 90 West street, New York, has issued a 52-page book containing instructions for the use of thermit in railroad shops. The subject is gone into in considerable detail and a number of tables as well as line drawings and half-tone illustrations are included. This book, which is known as pamphlet No. 21, second edition, will be found very useful in shops where thermit is used.

ELECTRICAL APPARATUS.—The Electric Controller & Manufacturing Company, Cleveland, Ohio, has issued an attractive booklet which contains an extract from a paper by H. F. Stratton in the December, 1913, issue of the Engineering Magazine, on the lifting of the Quebec bridge. With the exception of the motors, all of the electrical apparatus used in erecting the Quebec bridge is being designed and supplied by the Electric Controller & Manufacturing Company.

CAR HEATING.—The Gold Car Heating & Lighting Company, Whitehall building, New York, has issued a 44-page catalog dealing with the Gold electric car heating system. The details of the different heaters are illustrated very clearly, making the catalog of great assistance in ordering parts. One of the main features of the Gold electric heater, the ventilated porcelain core, is fully illustrated and described. This catalog also deals with the electric thermostatic control of steam heating which was described in the Railway Age Gazette, Mechanical Edition, for May. Several pages are also devoted to the Cyclone ventilator, which is also manufactured by the Gold Company.